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Voluntary Reporting of Greenhouse Gases 2001

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Energy Information Administration
Office of Integrated Analysis and Forecasting
U.S. Department of Energy
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This publication is on the WEB at:
www.eia.doe.gov/oiaf/1605/vrrpt/index.html.

For More Information

Individuals or members of organizations wishing to report reductions in emissions of greenhouse gases under the auspices of the Voluntary Reporting of Greenhouse Gases Program can contact the Energy Information Administration (EIA) at:

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For reporting purposes, the EIA has both a long form (EIA-1605) and a short form (EIA-1605EZ) available, as well as an electronic version of the form. They are available upon request or on EIA's web site at *www.eia.doe.gov/oiaf/1605/forms.html*.

The reports submitted to EIA are compiled into a database that can be obtained on CD-ROM by contacting the Voluntary Reporting of Greenhouse Gases Program Communications Center at 1-800-803-5182 or can be downloaded from EIA's web site at *www.eia.doe.gov/oiaf/1605/database.html*.

General or specific technical information concerning the contents of this report may also be obtained by contacting the Voluntary Reporting of Greenhouse Gases Program.

Preface

Title XVI, Section 1605(b) of the Energy Policy Act of 1992 (EPACT) directed the Energy Information Administration (EIA) to establish a mechanism for "the voluntary collection and reporting of information on . . . annual reductions of greenhouse gas emissions and carbon fixation achieved through any measures, including fuel switching, forest management practices, tree planting, use of renewable energy, manufacture or use of vehicles with reduced greenhouse gas emissions, appliance efficiency, methane recovery, cogeneration, chlorofluorocarbon capture and replacement, and power plant heat rate improvement . . . ."

The legislation further instructed EIA to create forms for the reporting of greenhouse gas emissions and reductions, and to establish a database of the information voluntarily reported under this subsection of EPACT. The reporting Forms EIA-1605 and EIA-1605EZ, "Voluntary Reporting of Greenhouse Gases," were first made available to the public in July 1995, providing a vehicle for voluntary reporting on activities that occurred before and during 1994. This publication summarizes data reported for 2001, the eighth year of data collection for the Voluntary Reporting of Greenhouse Gases Program.

The data reported to the Program are available through several media. All nonconfidential reports received by the Program are compiled into a Public Use Database, available on CD-ROM, on a set of diskettes, or by download from the Internet. The software is interactive and modular by design, allowing the user to select, view, or print the reports filed by the voluntary reporters, for each year of their participation. The user can also connect to and query the database with Microsoft Access 97 (or later versions) or other software that supports 32-bit open database connectivity (ODBC).

The Public Use Database and the current reporting software are also available at the Program's FTP (File Transfer Protocol) site on the Internet at *http://www.eia.doe.gov/oiaf/1605/database.html*. Interested parties are encouraged to visit the Program's home page at *http://www.eia.doe.gov/oiaf/1605/frntvrgg.html* for more information and background on the Program. Software, additional copies of this report, paper reporting forms, and technical support information can be downloaded from that web site or obtained from the Voluntary Reporting of Greenhouse Gases Communications Center by e-mail at *infoghg@eia.doe.gov*, toll-free at 1-800-803-5182, or locally at 202-586-0688.

This report was prepared under the guidance of Mary J. Hutzler, Director of EIA's Office of Integrated Analysis and Forecasting, and John Conti, Director of the International, Economic and Greenhouse Gases Division. Significant contributions to the Program, the current software, and the preparation of this report have been made by Paul McArdle, Stephen Calopedis, Mathew Aberant, Nancy Checklick, Elizabeth Crego, Laura Gehlin, Sarah Goldstein, William LaPerch, Michael Mondshine, Dick Richards, Charles L. Smith, and Peggy Wells.

EIA would like to express special thanks to the voluntary reporters, without whom this program would not be possible.

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Introduction

The Voluntary Reporting of Greenhouse Gases Program, required by Section 1605(b) of the Energy Policy Act of 1992, records the results of voluntary measures to reduce, avoid, or sequester greenhouse gas emissions. A total of 228 U.S. companies and other organizations reported to the Energy Information Administration (EIA) that, during 2001, they had undertaken 1,705 projects to reduce or sequester greenhouse gases. The reported greenhouse gas emission reductions for the projects reported included 222 million metric tons carbon dioxide equivalent of direct reductions, 71 million metric tons of indirect reductions, 8 million metric tons of reductions from carbon sequestration, and 15 million metric tons of unspecified reductions (Table ES1).[1]

The 228 entities reporting to the Voluntary Reporting Program for the 2001 reporting cycle represent a 3-percent decrease from the 236 entities reporting for 2000 (Table ES1); however, when the database was closed at the same time last year to allow preparation of the annual report, only 222 reports had been received for 2000. EIA received 14 reports after the 2000 database was closed last year. As of November 6, 2002, EIA has received 4 additional 2001 reports since the database was closed in early July 2002.

The number of entities reporting to the program has grown by 111 percent from its initiation when 108 entities reported in 1994. The number of projects reported has grown at a more rapid rate, because the number of projects reported by repeat reporters has increased. While the 1,705 projects reported for 2001 represents an increase of 169 percent over the 634 projects reported in 1994, the number of projects for 2001 has decreased significantly from the final tally of 2,089 projects reported for 2000, primarily as a result of the absence of two large reports from the 2001 database. American Forests (164 projects for 2000) did not submit a 2001 report, and Waste Management, Inc. (158 projects for 2000) submitted a 2001 report after the database was closed. The projects reported by these two entities are now included in the total reported for 2000 but not the total for 2001.

Of the 228 organizations reporting for 2001, 109 provided estimates of emissions and/or emission reductions for the entire organization—the same number as in 2000. Eighty-five of the reporters for 2001 recorded commitments to take action to reduce emissions, mostly during the 2000 to 2005 time frame.

Of the 109 organizations reporting at the entity level, 104 calculated their 2001 entity-wide greenhouse gas emissions. These entities reported direct greenhouse gas emissions of 903 million metric tons carbon dioxide equivalent, equal to about 15 percent of total U.S. greenhouse gas emissions in 2001. Also reported by these organizations were 147 million metric tons carbon dioxide equivalent of indirect emissions, equal to 2 percent of total U.S. greenhouse gas emissions in 2001. One hundred seven entity-level reporters also reported emission reductions, including 169 million metric tons carbon dioxide equivalent of direct emission reductions, 28 million metric tons carbon dioxide equivalent of indirect emission reductions, and 7 million metric tons carbon dioxide equivalent of emission reductions resulting from carbon sequestration projects.

Who Reported?

Reports for the 2001 data year were received from 228 participants in 25 different industries or services, which is fewer than the 30 different industries represented among 2000 reporters. The number of different industries represented still is higher than it was in the first year of the program (1994 data year), when the 108 reports received included participants in 9 different industries or services (Table ES2). In the early years of the program, reporting was dominated by the electric power sector. In the first reporting year, the 95 submissions from electric power producers represented 88 percent of the 108 reports received (Figure ES1). Since then, the program has seen an influx of new participants from outside the electric power sector, representing a diverse set of other industries. In addition, several mergers and acquisitions involving reporters to the program have accompanied the ongoing restructuring of the electric power industry. Many of these merged entities have

[1]For definitional purposes, direct reductions are emission reductions from sources owned or leased by the reporting entity, indirect reductions are emission reductions from sources not owned or leased by the reporting entity but that occur as a result of the entity's activities, carbon sequestration reductions represent the removal of atmospheric carbon to a carbon sink, and unspecified reductions represent emission reductions reported on Form EIA-1605EZ, on which the reporting entity cannot specify whether the emission reduction was a direct or indirect reduction.

Table ES1. Reporting Indicators for the Voluntary Reporting of Greenhouse Gases Program, Data Years 1994-2001

Indicator	1994	1995	1996	1997	1998	1999	2000(R)	2001
Number of Entities Reporting								
Long Form (EIA-1605)	73	101	109	122	159	166	199	196
Short Form (EIA-1605EZ)	35	41	41	40	48	41	37	32
Total	**108**	**142**	**150**	**162**	**207**	**207**	**236**	**228**
Number of Projects Reported								
Long Form (EIA-1605)	509	796	861	1,087	1,297	1,484	1,860	1,495
Short Form (EIA-1605EZ)	125	164	179	201	252	237	229	210
Total	**634**	**960**	**1,040**	**1,288**	**1,549**	**1,721**	**2,089**	**1,705**
Project-Level Reductions and Sequestration Reported on the Long Form (Million Metric Tons Carbon Dioxide Equivalent)								
Direct[a]	63	88	90	95	148	155	211	222
Indirect[b]	5	52	53	38	43	57	62	71
Sequestration[c]	1	1	9	10	12	10	9	8
Project-Level Reductions and Sequestration Reported on the Short Form[d] (Million Metric Tons Carbon Dioxide Equivalent)	**4**	**6**	**6**	**9**	**19**	**13**	**12**	**15**
Number of Entity-Level (Organization-Wide) Reports Received	**39**	**50**	**55**	**60**	**76**	**83**	**109**	**109**
Entity-Level Reductions and Sequestration Reported on the Long Form by Source (Million Metric Tons Carbon Dioxide Equivalent)								
Direct[a]	61	95	110	94	128	150	207	169
Basic Reference Case[e]	23	39	45	20	23	35	83	64
Modified Reference Case[f]	38	56	65	74	106	115	124	105
Indirect[d]	3	49	49	28	42	39	27	28
Basic Reference Case[c]	1	3	6	3	13	8	-8	-7
Modified Reference Case[b]	2	46	43	25	28	30	35	36
Sequestration[e]	0	1	8	7	11	8	7	7
Number of Entities Reporting Commitments for Future Reductions	**42**	**60**	**64**	**72**	**72**	**66**	**70**	**85**

[a]"Direct" emission reductions are reductions in releases of greenhouse gases "on site." For the purpose of completing Form EIA-1605, "on site" is defined as any source owned (wholly or in part) or leased by the reporting entity.

[b]"Indirect" emission reductions are reductions in emissions from sources not owned or leased by the reporting entity but that occur, wholly or in part, as a result of the entity's activities (for example, an automobile manufacturer's investment in increased automotive fuel economy can result in decreased emissions from vehicles owned by individuals or managed fleets).

[c]"Sequestration" is the fixation of atmospheric carbon dioxide in a carbon sink through biological or physical processes, such as photosynthesis.

[d]The short form does not allow reporters to distinguish among direct reductions, indirect reductions, and sequestration quantities.

[e]In a "basic reference case," actual emissions (or sequestration) are compared with an estimate of historical emissions (or sequestration) in a particular base year or average of years.

[f]In a "modified reference case," actual emissions (or sequestration) are compared to an estimate of what emissions (or sequestration) would have been in the absence of the project.

(R) = revised.

Notes: 2000 data have been revised upward to include 2000 reports that were submitted after the filing deadline. It is expected that the 2001 data will also be revised upward in next year's report with the inclusion of late 2001 reports. Totals for direct and indirect reductions may not equal sum of components due to independent rounding.

Source: Energy Information Administration, Forms EIA-1605 and EIA-1605EZ.

Table ES2. Forms Filed by Standard Industrial Classification, Data Years 1994-2001
(Number of Reports)

SIC Code[a]	Description	Data Year							
		1994	1995	1996	1997	1998	1999	2000[(R)]	2001
01	Agricultural Production: Crops	0	0	0	0	1	0	0	1
08	Forestry	1	2	1	1	3	3	1	0
12	Coal Mining	1	2	2	1	4	3	4	6
14	Nonmetallic Minerals, Except Fuels	0	0	0	0	1	1	0	0
20	Food and Kindred Products	0	0	0	0	1	2	6	4
22	Textile Mill Products	0	0	0	0	0	1	5	11
23	Apparel and Other Textile Products	0	0	0	0	0	0	1	1
24	Lumber and Wood Products	0	0	0	0	0	0	1	1
25	Furniture and Fixtures	0	0	0	0	0	0	1	1
26	Paper and Allied Products	0	0	0	0	0	1	1	0
27	Printing and Publishing	0	1	0	1	0	1	1	0
28	Chemical and Allied Products	1	3	2	3	8	5	11	9
29	Petroleum Refining and Other Related Industries	0	0	2	3	8	9	8	7
30	Rubber and Miscellaneous Plastic Products	0	0	0	0	0	0	2	2
32	Stone, Clay, Glass, and Concrete Products	0	0	1	4	12	13	7	5
33	Primary Metals Industries	2	2	4	4	5	5	5	11
34	Fabricated Metal Products, Except Machinery and Transportation Equipment	0	2	1	1	3	1	1	1
35	Industrial and Commercial Equipment and Components	0	0	0	0	0	0	1	1
36	Electronic and Other Electrical Equipment	1	1	2	4	4	4	9	8
37	Transportation Equipment	1	1	1	2	3	5	6	6
38	Instruments and Related Products	0	0	0	0	2	0	1	1
39	Miscellaneous Manufacturing Industries	0	1	1	0	2	2	1	1
48	Communications	0	0	0	0	0	1	0	0
49	Electric, Gas, and Sanitary Services	95	121	125	129	138	135	151	143
57	Furniture and Home Furnishings Stores	0	0	0	0	2	1	1	0
65	Real Estate	0	1	1	1	1	1	1	1
67	Holding and Other Investment Offices	0	0	1	1	1	1	1	1
72	Personal Services	0	0	0	0	0	0	1	1
80	Health Services	0	0	0	0	1	0	0	0
82	Educational Services	1	2	2	2	0	2	0	0
86	Membership Organizations	0	0	0	1	1	1	1	0
87	Engineering and Management Services	0	0	2	2	2	1	0	1
88	Private Households	2	1	1	1	1	1	1	1
89	Services Not Elsewhere Classified	0	0	0	1	1	3	2	1
91	Executive, Legislative, and General	0	0	0	0	1	2	2	2
97	National Security and International Affairs	0	0	0	0	0	0	1	0
Total Number of Reporters[b]		**108**	**142**	**150**	**162**	**207**	**207**	**236[c]**	**228**
Number of 2-Digit SIC Codes Represented		**9**	**13**	**16**	**18**	**24**	**26**	**30[c]**	**26**

[a]The Voluntary Reporting of Greenhouse Gases database was designed in 1994-1995, when the Standard Industrial Classification (SIC) system was still in use. For the 2003 data year reporting cycle, EIA intends to modify the database to use the North American Industry Classification System (NAICS), which was introduced in 1997 by the United States, Canada, and Mexico to provide comparability in statistics about business activity across North America.

[b]Totals may be greater than the sum of reporters in each SIC code, because confidential reporters are excluded from the latter.

[c]Includes 14 late reports for the 2000 data year. The 2001 total will also be revised upward in next year's report with the inclusion of late 2001 reports. As of November 15, 2001, EIA had received 4 late 2001 reports, which are not included in this report's 2001 database.

(R) = Revised.

Source: Energy Information Administration, Forms EIA-1605 and EIA-1605EZ.

submitted single, consolidated reports, thus reducing the number of reports received from electricity producers. As a result, only 45 percent of the organizations reporting to the program for data year 2001 were from the electric power sector.

Although the number of reporters from other individual industries remains relatively small, in many cases, reports were received from key companies in those other industries: for example, General Motors and the Ford Motor Company in the automotive products industry; Noranda and an operating division of Alcan in the metals industry; Sunoco, Inc., and ChevronTexaco Corporation in the petroleum industry; Johnson & Johnson and The Dow Chemical Company in the chemicals industry; Rolls Royce in the aerospace industry; Pharmacia & Upjohn Caribe, Inc., in the pharmaceuticals industry; and IBM and Motorola Austin in the electronic equipment industry.[2]

What Was Reported?

EIA collects information for the Voluntary Reporting Program on two forms: the long form (Form EIA-1605) and the short form (Form EIA-1605EZ). Three distinct types of reporting are permitted on Form EIA-1605:

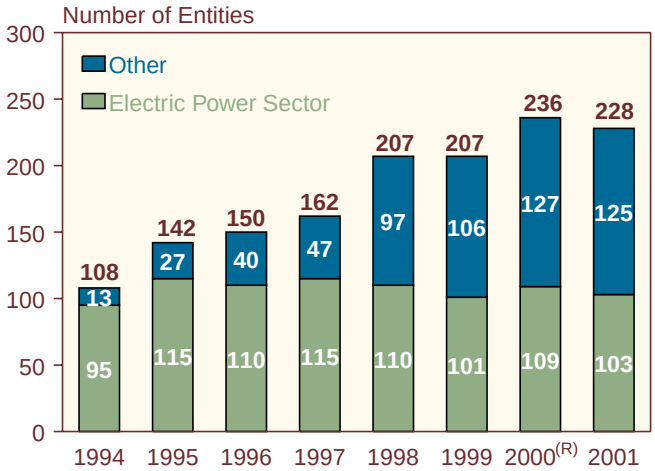
- Project-level emissions and reductions, defined as the emission reduction consequences of a particular action
- Entity-level emissions and reductions, defined as the emissions and reductions of an entire organization, usually defined as a corporation
- Commitments to take action to reduce emissions in the future.

Form EIA-1605EZ accommodates reporting on project-level reductions and sequestration only.

Of the 228 reports received, 196 (86 percent) were submitted on Form EIA-1605 and 32 on Form EIA-1605EZ (Figure ES2). The proportion of reporters using the short form has declined from 32 percent for 1994 to 14 percent for 2001. EIA believes that reporters are choosing the long form in order to document their emission reductions more thoroughly. Also, for the same reason, several government-sponsored voluntary programs, such as the U.S. Environmental Protection Agency's Landfill Methane Outreach Program, require or encourage participants to use the long form.

Most reporters (179 or 79 percent) reported projects, and 109 reported entity-level emissions and/or reductions. As these numbers imply, most (61) of the reporters that reported entity-level emissions or reductions also reported at the project level. One hundred eighteen organizations submitted only project-level reports, whereas 48 reported only entity-level information. Eighty-five reporters provided information on their commitments to reduce emissions or increase sequestration in the future.

Figure ES1. Electric Power Sector and Other Entities Submitting Reports to the Voluntary Reporting of Greenhouse Gases Program, Data Years 1994-2001

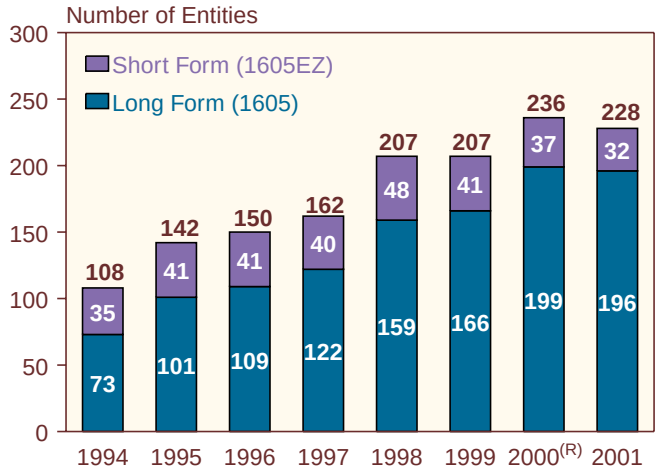


(R) = revised.

Notes: Electric power sector includes electric utilities and independent power producers. 2000 data year includes 14 late reports that were not included in the totals presented in last year's annual report and database.

Source: Energy Information Administration, Forms EIA-1605 and EIA-1605EZ.

Figure ES2. Number of Reports Received by Form Type, Data Years 1994-2001



(R) = revised.

Notes: Electric power sector includes electric utilities and independent power producers. 2000 data year includes 14 late reports that were not included in the totals presented in last year's annual report and database.

Source: Energy Information Administration, Forms EIA-1605 and EIA-1605EZ.

[2] A complete listing of all 2001 reporters is provided in Appendix B, Table B1.

Sources of greenhouse gas emissions and emission reductions reported to the Voluntary Reporting Program are characterized as direct, indirect, or unspecified. The unspecified category includes carbon sequestration reported on the long form and all reductions and sequestration reported on the short form. Because of concern about possible double counting, EIA does not aggregate reported emissions or emission reductions across the three categories.

Most reporters indicated that their projects were affiliated with one or more government-sponsored voluntary programs. Of the 1,705 projects reported for 2001, 1,041 were affiliated with the Climate Challenge Program, 180 with the Landfill Methane Outreach Program, 57 with the Climate Wise Recognition Program,[3] 37 with the U.S. Initiative on Joint Implementation, 33 with various Energy Star programs (including Energy Star Buildings, Energy Star Computers, and Energy Star Transformers), 17 with the Green Lights Program, 16 with the Natural Gas Star Program, 9 with the Sulfur Hexafluoride Emissions Reduction Partnership, 9 with the Coalbed Methane Outreach Program, 7 with Compressed Air Challenge, and 6 with WasteWise. Other voluntary programs cited included the Voluntary Aluminum Industrial Partnership, Motor Challenge, Rebuild America, and Steam Challenge. Not all participants in the various voluntary programs provided information to the Voluntary Reporting Program.

Projects Reported on the Long Form

Overview

Reporters provided detailed information on Form EIA-1605 on a total of 1,495 projects for 2001 (Table ES3). The total number of projects reported on the long form decreased by 365, or 20 percent, compared with the previous reporting cycle. A further 210 projects were reported on the short form, down 8 percent from the 229 projects reported for 2000.[4] Most of the projects reported for 2001 were also among the 2,089 projects reported for 2000, because they continued to yield emission reductions. Projects often yield emission reductions over an extended period of time; for example, an availability improvement project at a nuclear power plant typically involves the adoption of new maintenance and refueling programs that, once in place, are followed over a multi-year period. A project may even involve no new activity. The reforestation of an area in one year can

Table ES3. Distribution of Projects by Reduction Objective, Project Type, and Form Type, Data Year 2001

Reduction Objective and Project Type	Number of Projects			Number of Reporters		
	Long Form	Short Form	Total	Long Form	Short Form	Total
Reducing Carbon Dioxide Emissions	**841**	**146**	**987**	**132**	**36**	**168**
Electricity Generation, Transmission, and Distribution	373	50	423	72	23	95
Cogeneration and Waste Heat Recovery	18	0	18	11	0	11
Energy End Use	329	64	393	66	18	84
Transportation and Offroad Vehicles	53	13	66	31	6	37
Other Projects	68	19	87	40	9	49
Reducing Methane and Nitrous Oxide Emissions	**246**	**47**	**293**	**74**	**6**	**80**
Waste Treatment and Disposal (Methane)	208	45	253	54	4	58
Agriculture (Methane and Nitrous Oxide)	3	0	3	3	0	3
Oil and Natural Gas Systems and Coal Mining (Methane)	35	2	37	20	2	22
Carbon Sequestration	**369**	**14**	**383**	**51**	**12**	**63**
Halogenated Substances	**39**	**3**	**42**	**27**	**2**	**29**
Entity-Level Reporting Only (No Projects)	**NA**	**NA**	**NA**	**48**	**NA**	**48**
Commitment Reporting Only (No Projects or Entity-Level Data)	**NA**	**NA**	**NA**	**0**	**NA**	**0**
Total	**1,495**	**210**	**1,705**	**196**	**32**	**228**

NA = not applicable.

Notes: The total number of reporters is smaller than the sum of the number of reporters for each project type, because most reporters provided information on more than one project. Table excludes projects submitted in confidential reports.

Source: Energy Information Administration, Forms EIA-1605 and EIA-1605EZ.

[3]In fall 2000, EPA's Climate Wise partnerships were fully integrated under the Energy Star name.

[4]The number of projects reported for 2000 has increased from 1,882 to 2,089 with the receipt of several additional reports after, and revision of reports that had not been accepted by, the time the database used to prepare the annual report and Public Use Database for 2000 was finalized.

result in the sequestration of carbon in many subsequent years, even if no additional trees are planted. Reporters continue to report the annual emission reductions and carbon sequestration achieved by such long-lived projects on a yearly basis.

Most projects involve actions within the United States; however, some are conducted in foreign countries, designed to test various concepts of joint implementation with other nations (Table ES4). Fifty-eight of the 89 foreign projects represent shares in two forestry programs in Belize and Malaysia sponsored by the electric utility industry.

The principal objective of the majority of projects reported for 2001 was to reduce carbon dioxide emissions (Table ES3). Most of these projects reduced carbon dioxide either by reducing fossil fuel consumption or by switching to less carbon-intensive sources of energy. Many also achieved small reductions in emissions of other gases. A total of 900 projects involved either efficiency improvements and switching to less carbon-intensive sources in the electric power industry or energy end-use measures affecting stationary or mobile combustion sources. Projects that primarily reduced carbon dioxide emissions also included the 87 "other" emission reduction projects, most of which involved either the reuse of fly ash as a cement substitute in concrete or the recycling of waste materials.

Projects that primarily affected carbon dioxide emissions accounted for reported direct reductions of 187 million metric tons carbon dioxide equivalent, representing 76 percent of the total direct reductions reported for 2001 on a carbon dioxide equivalent basis. In addition, indirect reductions totaling 31 million metric tons carbon dioxide equivalent were also reported for the projects that reduced carbon dioxide emissions.

Almost all of the 369 carbon sequestration projects reported on the long form increased the amount of carbon stored in sinks through various forestry measures, including afforestation, reforestation, urban forestry, forest preservation, and modified forest management techniques. These activities accounted for 25 percent of the projects reported on the long form for 2001; 243 of the reported carbon sequestration projects represented 27 participating electric utilities' shares in 9 projects conducted by the UtiliTree Carbon Company. The sequestration reported for carbon sequestration projects on the long form for 2001 totaled 8 million metric tons carbon dioxide equivalent. Direct emission reductions totaling 1,114 metric tons carbon dioxide equivalent were also reported for a few carbon sequestration projects in which changes in forest management practices reduced fuel consumption. A further 14 carbon sequestration projects reported on the short form sequestered or avoided emissions of a reported 9,088 metric tons carbon dioxide equivalent.

A variety of efforts to reduce emissions of gases with high global warming potentials (GWPs) were also reported. Two hundred ninety-three of the reported projects (17 percent) reduced methane and nitrous oxide

Table ES4. Geographic Scope of Reports Received and Location of Emission Reduction Projects, Data Years 1994-2001

	Reports Received					Projects Reported			
	U.S. Only					U.S. Only			
Year	Long Form	Short Form	Foreign Only	Both U.S. and Foreign	Total[a]	Long Form	Short Form	Foreign Only	Total[a]
1994	65	34	2	4	**108**	500	125	9	**634**
1995	82	40	2	16	**142**	760	164	36	**960**
1996	83	41	1	24	**150**	828	179	33	**1,040**
1997	90	40	1	31	**162**	1,017	201	70	**1,288**
1998	118	47	1	40	**207**	1,212	252	85	**1,549**
1998	125	39	4	37	**207**	1,397	237	87	**1,721**
2000(R) . .	153	36	1	45	**236**	1,761	229	99	**2,089**
2001	153	32	1	41	**228**	1,405	210	90	**1,705**

[a]Totals are greater than the sum of the components because the latter exclude information from confidential reports.

(R) = revised

Notes: The number of report received for 2000 was revised to reflect the receipt of 14 reports after the finalization of the Public Use Database for last year's annual report. For 2000, additional reports were received from Branson Ultrasonics Corporation; CDX Gas, Inc.; City Utilities of Springfield; DuPont Company; Eaton Corporation – Commercial Controls Division; GeoMet, Inc.; Kansas City Power & Light Company; Naval Air Engineering Station Lakehurst; Pratt & Whitney, Middletown; Rochester Gas and Electric Corporation; Sikorsky Aircraft Corporation; Tacoma Public Utilities; Vermont Yankee Nuclear Power Corp.; and Waste Management, Inc. The number of projects reported for 2000 has also been revised to reflect the projects included in those reports. Table excludes projects submitted in confidential reports.

Source: Energy Information Administration, Forms EIA-1605 and EIA-1605EZ.

emissions from waste management systems, animal husbandry operations, oil and gas systems, or coal mines. The direct emission reductions for these projects totaled 29 million metric tons carbon dioxide equivalent, representing 13 percent of the total direct reductions reported for 2001. Indirect reductions reported for projects that reduced methane and nitrous oxide emissions totaled 40 million metric tons carbon dioxide equivalent. The 47 projects reported on the short form reduced emissions from unspecified sources by a reported 4 million metric tons carbon dioxide equivalent.

Forty-two projects reduced emissions of halogenated substances, including perfluorocarbons (PFCs) and sulfur hexafluoride (SF_6). For the second consecutive year, no offsetting increases in emissions of hydrofluorocarbons (HFCs)—which are used as substitutes for chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs) being phased out under the Montreal Protocol—were reported for 2001. Direct reductions of PFC and SF_6 emissions totaled 6 million metric tons carbon dioxide equivalent, representing more than 99 percent the PFC and SF_6 emission reductions reported for 2001. Reductions of other gases, including carbon monoxide (CO), nonmethane volatile organic compounds (NMVOCs), CFCs, and HCFCs, were reported, but these gases do not have reliable GWP values and are not included in the carbon dioxide equivalent data presented in this report.

Overall, direct project-level emission reductions reported for 2001 increased by 5 percent over those reported for 2000, to 222 million metric tons carbon dioxide equivalent, and were more than triple the reductions reported in the first year of the program (data year 1994). Reported reductions of indirect emissions for 2001 increased by 14 percent, to 71 million metric tons carbon dioxide equivalent. The sequestration reported peaked at 12 million metric tons for 1998 and fell to 8 million metric tons for 2001. The decline was caused by the absence of sequestration reported in previous years for several large forest preservation initiatives. Those projects avoided carbon releases associated with logging over the time period that the forests would have been harvested, which were reported as increased carbon sequestration over the same period. Unspecified emission reductions or sequestration reported on the short form increased from 12 million metric tons carbon dioxide equivalent for 2000 to 15 million metric tons carbon dioxide equivalent for 2001.

Project-Level Reference Cases

EIA has broken out project-level data by the reference case employed in calculating project-specific emission reductions. A "reference case" is an emissions or sequestration level against which actual emissions are compared in order to estimate emission reductions. In a "basic" reference case, actual historical emissions (or sequestration) in a specific year, or an average of a range of years, are used as the reference case. In a "modified" reference case, an estimate is made of what emissions or sequestration would have been in the absence of the project, and that estimate serves as the reference case.

The use of modified reference cases was reported for 90 percent of the projects reported for 2001 on Form EIA-1605 (Table ES5). A modified reference case is generally preferred for project-level analysis, because this approach attempts to isolate the effect of the action taken by the reporter from other factors that may have affected the reporter's emissions since the action was taken. The reported use of basic reference cases for 2001 was greatest for projects that involved reducing emissions of halogenated substances (56 percent), because the techniques for evaluating reductions are particularly suited to the use of basic reference cases. Emissions of a given halogenated substance are determined using inventory management data, with emissions of a particular substance being equal to the amount purchased during the year to replace quantities emitted. Reductions can be calculated by subtracting the emissions in the years after emission abatement measures have been instituted from the emissions in the year before the measures were instituted.

For the emission reductions and sequestration reported on the long form for 2001, 184 million metric tons carbon dioxide equivalent of direct reductions (83 percent of total direct reductions), 60 million metric tons carbon dioxide equivalent of indirect reductions (84 percent of total indirect reductions), and 7 million metric tons carbon dioxide equivalent of sequestration (93 percent of total sequestration reductions) were reported as having been estimated using modified reference cases (Table ES6).

Electric Power

In 2001, total emission reductions from electric power projects reported on the long form included 150 million metric tons carbon dioxide equivalent from direct sources and 18 million metric tons from indirect sources. Two hundred twenty-five projects that reduced the carbon content of fuels used to generate electricity were reported, with emission reductions totaling 138 million metric tons carbon dioxide equivalent from direct sources and 15 million metric tons from indirect sources. Reported emission reductions for projects increasing energy efficiency in generation, transmission, and distribution included 14 million metric tons carbon dioxide equivalent from direct sources and 3 million metric tons from indirect sources.

Table ES5. Number of Projects Reported on Form EIA-1605 by Reduction Objective, Project Type, and Reference Case Employed, Data Year 2001
(Number of Projects)

Reduction Objective and Project Type	Type of Reference Case				Total Number of Projects
	Modified		Basic		
	Number of Projects	Percent	Number of Projects	Percent	
Reducing Carbon Dioxide Emissions	**737**	**88**	**102**	**12**	**839**
Electricity Generation, Transmission, and Distribution	335	90	37	10	372
Cogeneration and Waste Heat Recovery	18	100	0	0	18
Energy End Use	279	85	50	15	329
Transportation and Offroad Vehicles	48	91	5	9	53
Other Projects	57	85	10	15	67
Reducing Methane and Nitrous Oxide Emissions	**239**	**97**	**7**	**3**	**246**
Waste Treatment and Disposal (Methane)	203	98	5	2	208
Agriculture (Methane and Nitrous Oxide)	3	100	0	0	3
Oil and Natural Gas Systems and Coal Mining (Methane)	33	94	2	6	35
Carbon Sequestration	**347**	**94**	**22**	**6**	**369**
Halogenated Substances	**17**	**44**	**22**	**56**	**39**
Total	**1,340**	**90**	**153**	**10**	**1,493**

Notes: Excludes projects reported on the short form (Form EIA-1605EZ), which does not collect information on the reference case employed. Excludes two projects reported on the long form (Form EIA-1605) for which no reference case was specified because reductions were not estimated. Table excludes projects submitted in confidential reports.
Source: Energy Information Administration, Forms EIA-1605.

Table ES6. Reported Emission Reductions and Sequestration for Projects Reported on Form EIA-1605 by Reduction Objective, Project Type, Source, and Reference Case Employed, Data Year 2001
(Metric Tons Carbon Dioxide Equivalent)

Reduction Objective and Project Type	Direct Reductions		Indirect Reductions		Sequestration	
	Modified	Basic	Modified	Basic	Modified	Basic
Reducing Carbon Dioxide Emissions	**154,982,618**	**32,197,213**	**21,770,401**	**9,690,390**	**0**	**0**
Electricity Generation, Transmission, and Distribution	115,529,789	31,540,675	7,490,690	8,996,412	0	0
Cogeneration and Waste Heat Recovery	2,596,231	0	1,120,865	0	0	0
Energy End Use	18,819,086	620,054	7,466,440	134,316	0	0
Transportation and Offroad Vehicles	8,511	36,484	86,152	1,871	0	0
Other Projects	18,029,000	0	5,606,255	557,790	0	0
Reducing Methane and Nitrous Oxide Emissions	**28,184,515**	**412,038**	**38,125,541**	**1,448,065**	**0**	**0**
Waste Treatment and Disposal (Methane)	13,065,760	401,981	38,084,338	1,448,065	0	0
Agriculture (Methane and Nitrous Oxide)	148	0	22,478	0	0	0
Oil and Natural Gas Systems and Coal Mining (Methane)	15,118,607	10,057	18,724	0	0	0
Carbon Sequestration	**1,114**	**0**	**0**	**0**	**7,423,920**	**532,904**
Halogenated Substances	**631,268**	**5,448,794**	**81**	**0**	**0**	**0**
Total	**183,799,514**	**38,058,045**	**59,896,022**	**11,138,454**	**7,423,920**	**532,904**

Note: Excludes reductions and sequestration for projects reported on the short form (Form EIA-1605EZ), which does not collect information on the reference case employed. Excludes projects submitted in confidential reports.
Source: Energy Information Administration, Form EIA-1605.

Energy End Use

Reported reductions for the 329 energy end-use projects reported on the long form included 19 million metric tons carbon dioxide equivalent from direct sources and 8 million metric tons from indirect sources. Energy end-use reductions were reported for stationary-source applications, such as building shell improvements, lighting and lighting control, appliance improvement or replacement, and heating, ventilation and air conditioning (HVAC) improvements. Much smaller reductions were reported for the 53 transportation projects reported on the long form, including 45 thousand metric tons carbon dioxide equivalent from direct sources and 88 thousand metric tons from indirect sources.

Carbon Sequestration

Sequestration or avoided emissions of 8 million metric tons carbon dioxide equivalent were reported for 369 carbon sequestration projects reported on the long form for 2001. Most of the reported reductions resulted from afforestation, reforestation, urban forestry, forest management, and forest preservation efforts.

Methane Emissions

In 2001, emission reductions for the 246 methane abatement projects reported on the long form included 29 million tons carbon dioxide equivalent from direct sources and 40 million metric tons from indirect sources. The three most frequently reported sources of methane reductions were municipal waste landfills (198 projects), natural gas systems (19 projects), and coal mines (16 projects). In addition to reducing methane emissions, projects that involved the recovery and use of methane for energy also reduced carbon dioxide emissions by displacing fossil fuels, such as oil and coal that have higher carbon contents and thus produce more carbon dioxide when burned.

HFCs, PFCs, and Sulfur Hexafluoride

More than 99 percent of the reductions for the 39 projects reducing emissions of HFCs, PFCs, and SF_6 in 2001 reported on the long form were direct. The reported reductions from direct sources totaled 6.1 million metric tons carbon dioxide equivalent, compared with only 81 metric tons carbon dioxide equivalent in reported reductions from indirect sources. The largest reported reductions were direct reductions in perfluoromethane (3.0 million metric tons carbon dioxide equivalent), SF_6 (2.5 million metric tons carbon dioxide equivalent), and perfluoroethane (0.6 million metric tons carbon dioxide equivalent).

Projects Reported on the Short Form

Two hundred ten projects were reported by 32 entities on the short form (Table ES3), 127 of which (60 percent) were efforts that affected emissions of carbon dioxide from electricity generation, transmission, and distribution, energy end use, and transportation. Such projects reduced emissions by a reported 10 million metric tons carbon dioxide. Reductions totaling 4 million metric tons carbon dioxide equivalent were reported for 47 projects involving waste treatment and disposal and oil and natural gas systems and coal mining. Carbon sequestration or avoided emissions of carbon dioxide were reported for 14 projects and totaled 9 thousand metric tons carbon dioxide equivalent. Three projects reported reductions of halogenated substances, including PFCs and SF_6, totaling 11 thousand metric tons carbon dioxide equivalent. Nineteen other projects reported on the short form included recycling and fly ash reuse, for which reductions of 1 million metric tons carbon dioxide equivalent were reported.

Entity-Level Reporting

Most of the 109 reporters providing entity-level information included data on emissions as well as emission reductions or sequestration. Three reporters provided entity-level data on emissions only, and another 5 reporters provided entity-level data on emission reductions or sequestration only.

Total direct entity-level emissions of greenhouse gases reported for 2001 were 903 million metric tons, representing a 15-percent decrease from the 1,068 million metric tons reported for 2000 (Table ES7). Direct emission reductions reported at the entity level totaled 169 million metric tons carbon dioxide equivalent for 2001, 18 percent less than the 207 million metric tons carbon dioxide equivalent reported for 2000. For 2001, 105 million metric tons carbon dioxide equivalent (62 percent) of the reported direct reductions were estimated using modified reference cases, and 38 percent were estimated with basic reference cases.

Reported indirect entity-level emission reductions for 2001 totaled 28 million metric tons carbon dioxide equivalent. Reported indirect reductions of 36 million metric tons carbon dioxide equivalent calculated with modified reference cases were offset by -7 million metric tons carbon dioxide equivalent reported for indirect reductions (i.e., a net emission increase) calculated with basic

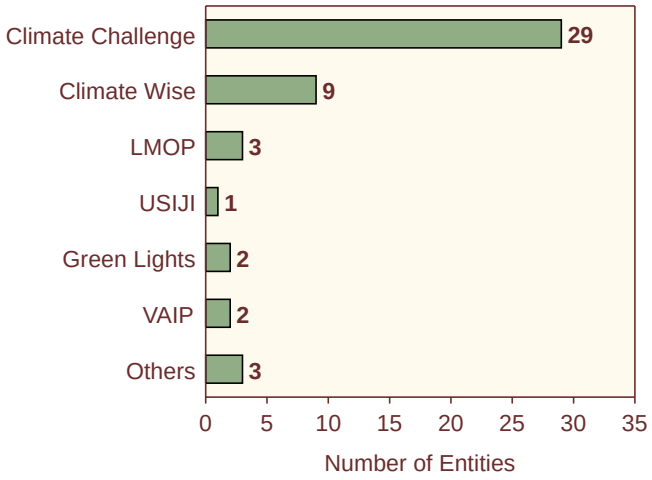
reference cases. Up until the 2000 data year, the total of reported indirect emission reductions calculated using basic reference cases was a positive number. The shift to a negative total occurred in the 2000 data year when two reports, which previously had incorrectly reported reductions using basic reference cases, were corrected to reported increases. Entity-level sequestration reported for 2001 remained at 7 million metric tons carbon dioxide equivalent, unchanged from the amount reported for 2000.

Commitments

Eighty-five entities reported formal commitments to reduce future emissions, to take action to reduce emissions in the future, or to provide financial support for activities related to greenhouse gas reductions.[5] More than one-third (34 percent) of these entities are electricity generators participating in the Climate Challenge Program (Figure ES3). Fifty-six other entities also reported commitments. Other voluntary programs represented among the commitments reported for 2001 included Climate Wise, the Voluntary Aluminum Industrial Program, the U.S. Initiative on Joint Implementation, the Green Lights Program, the Landfill Methane Outreach Program, the Coalbed Methane Outreach Program, Motor Challenge, and the Sulfur Hexafluoride Emissions Reduction Partnership for Electric Power Systems.

There are three forms of future commitment in the Voluntary Reporting Program: entity commitments, financial commitments, and project commitments. Entity and project commitments roughly parallel the entity and project aspects of emissions reporting: an entity commitment is a commitment to reduce the

Figure ES3. Number of Entities Reporting Commitments Associated with Voluntary Programs in Data Year 2001, by Program



Notes: LMOP = Landfill Methane Outreach Program, USIJI = United States Initiative on Joint Implementation, VAIP = Voluntary Aluminum Industry Partnership. Others include Coalbed Methane Outreach Program, Cool Communities Program, Motor Challenge Program, and Sulfur Hexafluoride Emissions Reduction Partnership for Electric Power Systems. The sum of entities reporting commitments associated with each program exceeds the total number of entities reporting commitments because several entities reported commitments associated with more than one program.

Source: Energy Information Administration, Form EIA-1605.

Table ES7. Number of Entities Reporting at the Entity Level, Reported Emissions by Source, Emission Reductions by Source and Type of Reference Case Employed, and Sequestration, Data Years 1994-2001

(Million Metric Tons Carbon Dioxide Equivalent)

Year	Number of Entities Reporting	Emissions		Emission Reductions by Type of Reference Case						Sequestration
				Direct			Indirect			
		Direct	Indirect	Modified	Basic	Total	Modified	Basic	Total	
1994	39	752.7	494.9	38.2	22.6	60.8	1.6	1.2	2.8	0.5
1995	50	875.8	499.6	56.0	39.3	95.3	46.0	2.7	48.6	0.8
1996	55	1,183.1	461.5	65.4	44.6	110.0	42.9	5.7	48.6	7.9
1997	60	1,006.6	525.8	73.7	20.3	94.0	24.8	3.4	28.2	7.1
1998	76	1,110.7	473.5	105.8	22.6	128.4	28.3	13.2	41.6	11.2
1999	83	967.9	481.0	114.7	35.3	150.0	30.3	8.4	38.7	8.4
2000(R) . .	109	1,068.2	111.7	123.6	83.0	206.7	34.8	-7.8	27.0	7.5
2001	109	902.9	146.7	104.9	64.3	169.2	35.7	-7.3	28.4	7.5

(R) = revised.

Notes: 2000 data year includes late reports that were not included in the number of entities submitting 2000 data reports in time to be included in last year's annual report and database. Negative reductions represent increases in emissions.

Source: Energy Information Administration, Form EIA-1605.

[5]Fifty companies reported formal commitments in one or more of the entity-level, project-level, or financial categories accommodated by Form EIA-1605. Thirty-five companies provided only descriptions of future activities in the Additional Information section of Schedule IV.

emissions of an entire organization; a project commitment is a commitment to take a particular action that will have the effect of reducing the reporter's emissions through a specific project. A financial commitment is a pledge to spend a particular sum of money on activities related to emission reductions, without a specific promise as to the emissions consequences of the expenditure.

Twenty-five firms made 32 specific promises to reduce, avoid, or sequester future emissions at the entity level. Some of these entity-level commitments were to reduce emissions below a specific baseline, others to limit the growth of emissions per unit of output, and others to limit emissions by a specific amount relative to a baseline emissions growth trend. In their reports for 2001, companies committed to reducing future entity-level emissions by a total of 94.4 million metric tons carbon dioxide equivalent. Forty-four percent of entity-level emission reduction commitments were for the year 2000, with an additional 31 percent falling within the 2001 to 2005 time horizon.

Twenty-nine companies reported on commitments to undertake 182 individual emission reductions projects. Some of the commitments were linked to future results from projects already underway and forming part of the reporters' submissions. Others were for projects not yet begun. Reporters indicated that the projects were expected to reduce future emissions by 151 million metric tons carbon dioxide equivalent, most of which (90 million metric tons carbon dioxide equivalent, or 60 percent) would be reductions of methane emissions.

Twenty-one firms made 39 separate financial commitments. The total amount of funds promised was $51 million, of which $7 million was reported to have been spent in 2001.

Climate Change Policy Developments

Several policy initiatives were introduced in the United States over the past year to address the issue of global climate change. In 2002, the White House announced the Global Climate Change Initiative, which included enhancement of the Voluntary Reporting of Greenhouse Gases Program; Congress proposed new energy legislation; and States and other organizations continued to develop innovative greenhouse gas registry and trading programs. The policy developments in 2002 would not have affected the reported emissions and emission reductions for activities in 2001 discussed in this report; however, each of these policy efforts may play a significant role in the future of the Voluntary Reporting of Greenhouse Gases Program.

Global Climate Change Initiative

On February 14, 2002, President George W. Bush announced the Administration's Global Climate Change Initiative, which includes new emission intensity reduction goals, incentives for clean technology development, added support for scientific research, an agenda for expanded collaboration with foreign governments, and a framework for the enhancement of the Voluntary Reporting of Greenhouse Gases Program.

A primary goal of the Global Climate Change Initiative is to slow the growth rate of greenhouse gas emissions while sustaining economic growth, using market mechanisms and energy technology development. In the proposal, the President established a national goal of reducing the greenhouse gas intensity of the U.S. economy by 18 percent over the next 10 years. Emissions intensity is a measure of the ratio of emissions to economic output (gross domestic product). To achieve the goal, the Initiative focuses on fossil fuel energy conservation, methane recovery, and carbon sequestration in the short term and development of advanced energy technologies in the longer term.

As the Global Climate Change Initiative will rely on voluntary measures to achieve emission reduction goals, enhancing the Voluntary Reporting of Greenhouse Gases Program is an important part of the initiative (see below). The Initiative also includes several other domestic and international elements, such as expanded funding for basic scientific research and advanced technology development; tax incentives; challenges for business to undertake voluntary initiatives and commit to greenhouse gas intensity goals; fuel economy standards; carbon sequestration programs; economic incentives to encourage developing countries to participate in climate change initiatives; and technology transfer and capacity building in the developing world.

The Global Climate Change Initiative includes a future progress check, through which the United States, in 2012, will evaluate whether its greenhouse gas emissions reduction progress is sufficient and whether scientific understanding at that time will justify further action. If further action is deemed necessary, the Initiative proposes to accelerate technology development and deployment using additional market-based mechanisms, voluntary measures, and incentive programs.

Enhanced 1605(b) Voluntary Emissions Reduction Registry

Pursuant to a key objective of the Global Climate Change Initiative, the Department of Energy, in conjunction with the Departments of Agriculture and Commerce and the Environmental Protection Agency, is

working to improve and expand the 1605(b) Voluntary Reporting of Greenhouse Gases Program. The primary goal is to create a credible and transparent program to report real reductions that support the President's goal of reducing greenhouse gas intensity by 18 percent over the next 10 years. In addition, the enhanced 1605(b) Program envisioned by the Initiative will allow businesses and individuals to record their reductions and ensure that those reporters are not penalized under a future climate policy. The objective of improving the registry and providing transferable credits for reductions is to help motivate firms to take cost-effective, voluntary actions to reduce greenhouse gas emissions, which would be necessary to achieve the Global Climate Change Initiative's greenhouse gas intensity goal.

Since February, when the President announced his new initiative, an interagency working group has undertaken several actions to improve the Voluntary Reporting Program, including outreach efforts, solicitation of public comments, and a review of the existing program. On July 8, 2002, the Secretary of Energy, joined by the Secretary of Commerce, the Secretary of Agriculture, and the Administrator of the Environmental Protection Agency, submitted recommendations to the White House that will guide the process over the coming months to improve and expand the Voluntary Reporting Program.[6]

Specifically, the Secretaries and Administrator recommended the following improvements to the 1605(b) program:

- Develop fair, objective, and practical methods for reporting baselines, reporting boundaries, calculating real results, and awarding transferable credits for actions that lead to real reductions
- Standardize widely accepted, transparent accounting methods
- Support independent verification of registry reports
- Encourage reporters to report greenhouse gas intensity (emissions per unit of output) as well as emissions or emission reductions
- Encourage corporate or entity-wide reporting
- Provide credits for actions to remove carbon dioxide from the atmosphere (e.g., sequestration activities) as well as for actions to reduce emissions
- Develop a process for evaluating the extent to which past reductions may qualify for credits
- Ensure that the voluntary reporting program is an effective tool for reaching the goal of an 18-percent reduction in greenhouse gas intensity
- Factor in international strategies as well as State-level efforts
- Minimize transactions costs for reporters and administrative costs for the Government, where possible, without compromising the foregoing recommendations.

The Secretaries and the Administrator proposed a process, to culminate in new guidelines by January 2004 (for reporting 2003 data), that includes: several stakeholder workshops; revision of the technical guidelines based on analysis and workshops; public comment periods to review the revised guidelines; and development of reporting forms, software, and a database.

Legislation Relevant to Voluntary Greenhouse Gas Reporting Introduced in the 107th U.S. Congress

The Energy Policy Act of 2002, which did not clear a House-Senate conference before the 107th Congress recessed for the elections in November 2002, was the product of the House energy bill, H.R. 4, introduced in 2001 amended to include text from the Senate energy bill, S. 517, reintroduced by Senators Daschle and Bingaman in March 2002. S. 517 contained provisions that called for an enhanced voluntary reporting program and incentives for emission reductions. The relevant language was taken from S. 517, because H.R. 4 did not contain any greenhouse gas registry provisions.

In April 2002, before the merging of the Title XI language from S. 517 into H.R. 4, Representative Olver introduced H.R. 4611, The National Greenhouse Gas Emissions Inventory Act of 2002, which contained provisions that responded to the President's climate change proposal. Both S. 517 and H.R. 4611, using much of the same language, would establish greenhouse gas registries. Both bills would establish mandatory reporting for entities that exceed an emissions threshold (e.g., 10,000 metric tons carbon dioxide equivalent per year). In addition, both bills would allow voluntary reporting of emission reductions, but neither would require third-party verification. One difference between the bills is that H.R. 4611 specifies that a purpose of the mandatory greenhouse gas inventory, registry, and information system is to avoid penalizing early action to reduce emissions, whereas S. 517 does not identify that purpose.

[6]See U.S. Department of Energy, Office of Policy and International Affairs, "Enhancing the Department of Energy's Registry of Greenhouse Gas Emissions and Emission Reductions," web site www.pi.energy.gov/enhancingGHGregistry/index.html (December 31, 2002).

Other U.S., State, and International Greenhouse Gas Registry Programs

Voluntary greenhouse gas emissions reporting programs and other State initiatives, such as emissions targets, emissions inventorying and monitoring, and emissions mitigation strategies, are gaining momentum as States investigate the most cost-effective policies to address climate change. California, New Hampshire, Wisconsin, New Jersey, Maine, Oregon, and the coordinated New England States and Canadian Provinces have continued separate efforts to develop greenhouse gas registry programs by enacting legislation and establishing rules and guidance.

At the national level, on February 12, 2003, the U.S. Department of Energy, on behalf of President Bush, launched the President's "Climate VISION" (Voluntary Innovative Sector Initiatives: Opportunities Now)—a voluntary public-private partnership to pursue cost-effective initiatives to reduce the projected growth in U.S. greenhouse gas emissions. Climate VISION, to be administered through the Department of Energy, is intended to help meet the President's goal of reducing U.S. greenhouse gas intensity—the ratio of emissions to economic output—by 18 percent by 2012.

Climate VISION involves Federal agencies, including the Department of Energy, the U.S. Environmental Protection Agency, and the Departments of Agriculture and Transportation, working with industry partners to reduce greenhouse gas emissions voluntarily over the next decade. Industry groups making commitments include the Alliance of Automobile Manufacturers, Aluminum Association, American Chemistry Council, American Forest and Paper Association, American Iron and Steel Institute, American Petroleum Institute, American Public Power Association, Association of American Railroads, Business Roundtable, Edison Electric Institute, Electric Power Supply Association, Magnesium Coalition and International Magnesium Association, National Mining Association, National Rural Electric Cooperative Association, Nuclear Energy Institute, Portland Cement Association, and Semiconductor Industry Association.

The Environmental Protection Agency (EPA) has also established Climate Leaders, a new voluntary industry-government partnership to encourage companies to establish clear greenhouse gas reduction targets and develop long-term comprehensive climate change strategies. The EPA published several draft Greenhouse Gas Inventory Protocol documents in 2002 and is soliciting public feedback.

Finally, a number of groups internationally and within the private sector are setting up greenhouse gas protocols, registries, and trading exchanges:

- The World Resources Institute and the World Business Council for Sustainable Development are collaborating on the Greenhouse Gas Protocol Initiative, which is an international program for developing universal accounting and reporting standards for greenhouse gas emissions and reductions that can be adopted by other reporting programs and registries. A similar effort is taking place within the International Standards Organization (ISO).
- The American Petroleum Institute has developed a protocol for estimating greenhouse gas emissions in the oil and gas industry.
- Voluntary greenhouse gas registries have emerged in Canada, the United Kingdom, Australia, and the Netherlands.
- The Chicago Climate Exchange (CCX) is targeted to open in the spring of 2003. CCX is a voluntary cap-and-trade program. Participating members will be able to buy and sell greenhouse gas credits to assist in achieving their emission reduction commitments.

1. Voluntary Reporting 2001: An Overview

Introduction

The Energy Policy Act of 1992 (EPACT) directed the U.S. Department of Energy (DOE), with the Energy Information Administration (EIA) as the implementing agency, to develop a program to document voluntary actions that reduce emissions of greenhouse gases or remove greenhouse gases from the atmosphere (see box on page 2).[1] The Voluntary Reporting of Greenhouse Gases Program was developed in cooperation with DOE's Office of Policy and International Affairs and the U.S. Environmental Protection Agency (EPA). In addition to providing recognition for entities that reduce greenhouse gas emissions or sequester carbon voluntarily, the program serves to identify innovative and effective ways of reducing emissions.

This report presents information on the eighth reporting cycle of the Voluntary Reporting Program, which accepted reports including information on emissions, emission reductions, and carbon sequestration activities through 2001. The report is divided into eight chapters. This chapter provides an overview of participation in the Voluntary Reporting Program, a perspective on the composition of activities reported, and a review of some key issues in interpreting and evaluating achievements associated with reported emission mitigation initiatives. Chapters 2 through 6 provide a more detailed review of project-level emission reduction initiatives reported to the program. Chapter 2 examines projects in the electricity sector that reduce carbon dioxide emissions through thermal efficiency improvements or switching to lower emitting fossil fuels. Chapter 3 considers improvements in end-use efficiency and fuel switching in the residential, commercial, industrial, and transportation sectors.

Activities to improve or expand carbon sinks through such activities as reforestation, afforestation, and forest preservation are the subject of Chapter 4. Emission reduction initiatives associated with methane and halogenated substances are examined in Chapters 5 and 6, respectively. Chapter 7 reviews emissions reports from participants who provided data on aggregate entity emissions. Chapter 8 summarizes information on emission reductions and carbon sequestration projects reported in brief on the short form (Form EIA-1605EZ). Appendixes (available on web site *http://www.eia.doe.gov/oiaf/1605/vrrpt/index.html*) provide information on the development and structure of the data collection instrument, a discussion of issues in the interpretation of the data, and tabular summaries of the participating reporters and the information they reported.

The reports submitted to EIA are compiled into a database that can be obtained on CD-ROM by contacting the Voluntary Reporting of Greenhouse Gases Program Communications Center at 1-800-803-5182 or downloaded from EIA's web site at *http://www.eia.doe.gov/oiaf/1605/database.html*.

Benefits of the Voluntary Reporting Program

The Voluntary Reporting Program is unique among the many voluntary programs initiated during the early 1990s in its diversity of project types, participation, and approaches. The Voluntary Reporting Program's database provides abundant examples of the types of concrete actions that organizations can undertake to reduce greenhouse gas emissions. Some of the most important benefits of the Voluntary Reporting Program are:[2]

- The program has served to teach staff at many of the largest corporations in the United States how to estimate greenhouse gas emissions and has educated them on a range of possible measures to limit emissions.
- The program has helped to provide concrete evidence for the evaluation of activities reported to the many government voluntary programs launched since 1993.
- Reporters have been able to learn about innovative emission reduction activities from the experiences of their peers.

[1]Title XVI of the Energy Policy Act, Public Law 102-486 (October 24, 1992), in Section 1605(a) called for an annual report on national aggregate emissions of greenhouse gases. EIA has issued the report—*Emissions of Greenhouse Gases in the United States*—every year since 1993. Section 1605(b) called for the establishment of a database of annual emissions and reductions of emissions reported on a voluntary basis.

[2]Testimony of Jay Hakes, former EIA Administrator, on March 30, 2000, before the Senate Committee on Energy and Natural Resources on Senate Bills S.882 and S.1776 and their potential impacts on EIA's Programs. The full text of the testimony is available on EIA's web site at www.eia.doe.gov/neic/speeches/hrtest3-30-00/testimony3.htm.

- The program has created a "test" database of approaches to emission reductions that can be used to evaluate future policy instruments aimed at limiting emissions.
- The program has helped to illuminate many of the poorly appreciated emissions accounting issues that must be addressed in designing any future approaches to emission limitations.

Who Reported?

Reports for the 2001 data year were received from 228 participants in 25 different industries or services (defined by the two-digit Standard Industrial Classification code), fewer than the 30 different industries represented among 2000 reporters. In comparison, reports for the 1994 data year—the first year of the program—were received from 108 participants in 9 different industries or services (Table 1).

In the early years of the program, reporting was dominated by the electric power sector. In the first reporting year (data year 1994), the 95 submissions from electric power producers represented 88 percent of the 108 reports received (Figure 1). Since then, the program has seen an influx of new participants from outside the electric power sector, representing a diverse set of other industries. In addition, the ongoing restructuring of the electric power industry has been accompanied by several mergers and acquisitions involving reporters to the program, reducing the number of reports received from electricity producers. As a result, only 45 percent of the organizations reporting to the program for data year 2001 were from the electric power sector.

The Energy Policy Act of 1992, Sections 1605(b) and (c)

(b) Voluntary Reporting.—

(1) ISSUANCE OF GUIDELINES.—Not later than 18 months after the date of the enactment of this Act, the Secretary shall, after opportunity for public comment, issue guidelines for the voluntary collection and reporting of information on sources of greenhouse gases. Such guidelines shall establish procedures for the accurate voluntary reporting of information on—

(A) greenhouse gas emissions—

(i) for the baseline period of 1987 through 1990; and

(ii) for subsequent calendar years on an annual basis;

(B) annual reductions of greenhouse gas emissions and carbon fixation achieved through any measures, including fuel switching, forest management practices, tree planting, use of renewable energy, manufacture or use of vehicles with reduced greenhouse gas emissions, appliance efficiency, methane recovery, cogeneration, chlorofluorocarbon capture and replacement, and power plant heat rate improvement;

(C) reductions in greenhouse gas emissions achieved as a result of—

(i) voluntary reductions;

(ii) plant or facility closings; and

(iii) State or Federal requirements; and

(D) an aggregate calculation of greenhouse gas emissions by each reporting entity.

Such guidelines shall also establish procedures for taking into account the differential radiative activity and atmospheric lifetimes of each greenhouse gas.

(2) REPORTING PROCEDURES.—The Administrator of the Energy Information Administration shall develop forms for voluntary reporting under the guidelines established under paragraph (1), and shall make such forms available to entities wishing to report such information. Persons reporting under this subsection shall certify the accuracy of the information reported.

(3) CONFIDENTIALITY.—Trade secret and commercial or financial information that is privileged or confidential shall be protected as provided in section 552(b)(4) of title 5, United States Code.

(4) ESTABLISHMENT OF DATA BASE.—Not later than 18 months after the date of the enactment of this Act, the Secretary through the Administrator of the Energy Information Administration shall establish a data base comprised of information voluntarily reported under this subsection. Such information may be used by the reporting entity to demonstrate achieved reductions of greenhouse gases.

(c) Consultation.—

In carrying out this section, the Secretary shall consult, as appropriate, with the Administrator of the Environmental Protection Agency.

Table 1. Forms Filed by Standard Industrial Classification, Data Years 1994-2001
(Number of Reports)

SIC Code[a]	Description	Data Year							
		1994	1995	1996	1997	1998	1999	2000(R)	2001
01	Agricultural Production: Crops	0	0	0	0	1	0	0	1
08	Forestry	1	2	1	1	3	3	1	0
12	Coal Mining	1	2	2	1	4	3	4	6
14	Nonmetallic Minerals, Except Fuels	0	0	0	0	1	1	0	0
20	Food and Kindred Products	0	0	0	0	1	2	6	4
22	Textile Mill Products	0	0	0	0	0	1	5	11
23	Apparel and Other Textile Products	0	0	0	0	0	0	1	1
24	Lumber and Wood Products	0	0	0	0	0	0	1	1
25	Furniture and Fixtures	0	0	0	0	0	0	1	1
26	Paper and Allied Products	0	0	0	0	0	1	1	0
27	Printing and Publishing	0	1	0	1	0	1	1	0
28	Chemical and Allied Products	1	3	2	3	8	5	11	9
29	Petroleum Refining and Other Related Industries	0	0	2	3	8	9	8	7
30	Rubber and Miscellaneous Plastic Products	0	0	0	0	0	0	2	2
32	Stone, Clay, Glass, and Concrete Products	0	0	1	4	12	13	7	5
33	Primary Metals Industries	2	2	4	4	5	5	5	11
34	Fabricated Metal Products, Except Machinery and Transportation Equipment	0	2	1	1	3	1	1	1
35	Industrial and Commercial Equipment and Components	0	0	0	0	0	0	1	1
36	Electronic and Other Electrical Equipment	1	1	2	4	4	4	9	8
37	Transportation Equipment	1	1	1	2	3	5	6	6
38	Instruments and Related Products	0	0	0	0	2	0	1	1
39	Miscellaneous Manufacturing Industries	0	1	1	0	2	2	1	1
48	Communications	0	0	0	0	0	1	0	0
49	Electric, Gas, and Sanitary Services	95	121	125	129	138	135	151	143
57	Furniture and Home Furnishings Stores	0	0	0	0	2	1	1	0
65	Real Estate	0	1	1	1	1	1	1	1
67	Holding and Other Investment Offices	0	0	1	1	1	1	1	1
72	Personal Services	0	0	0	0	0	0	1	1
80	Health Services	0	0	0	0	1	0	0	0
82	Educational Services	1	2	2	2	0	2	0	0
86	Membership Organizations	0	0	0	1	1	1	1	0
87	Engineering and Management Services	0	0	2	2	2	1	0	1
88	Private Households	2	1	1	1	1	1	1	1
89	Services Not Elsewhere Classified	0	0	0	1	1	3	2	1
91	Executive, Legislative, and General	0	0	0	0	1	2	2	2
97	National Security and International Affairs	0	0	0	0	0	0	1	0
Total Number of Reporters[b]		**108**	**142**	**150**	**162**	**207**	**207**	**236[c]**	**228**
Number of 2-Digit SIC Codes Represented		**9**	**13**	**16**	**18**	**24**	**26**	**30[c]**	**26**

[a]The Voluntary Reporting of Greenhouse Gases database was designed in 1994-1995, when the Standard Industrial Classification (SIC) system was still in use. For the 2003 data year reporting cycle, EIA will modify the database to use the North American Industry Classification System (NAICS), which was introduced in 1997 by the United States, Canada, and Mexico to provide comparability in statistics about business activity across North America.

[b]Totals may be greater than the sum of reporters in each SIC code, because confidential reporters are excluded from the latter.

[c]Includes 14 late reports for the 2000 data year. The 2001 total will also be revised upward in next year's report with the inclusion of late 2001 reports. As of November 15, 2001, EIA had received 4 late 2001 reports, which are not included in this report's 2001 database.

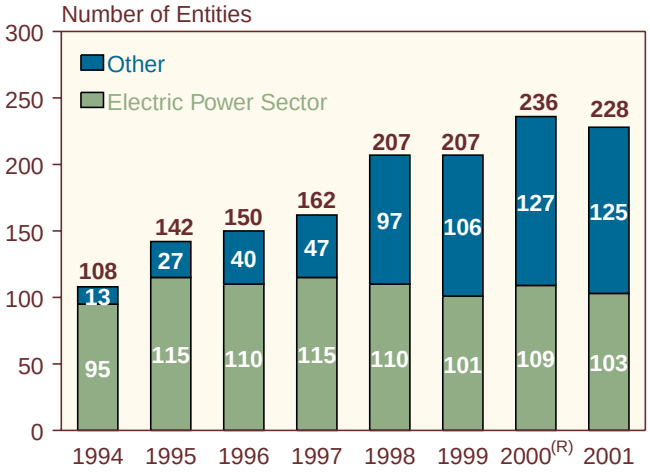
(R) = Revised.

Source: Energy Information Administration, Forms EIA-1605 and EIA-1605EZ.

Although the number of reporters from other individual industries remained relatively small, in many cases, reports were received from key companies in those other industries: for example, General Motors and Ford Motor Company in the automotive products industry; Noranda and an operating division of Alcan in the metals industry; BP, Sunoco, Inc., and ChevronTexaco Corporation in the petroleum industry; Johnson & Johnson and The Dow Chemical Company in the chemicals industry; Rolls Royce in the aerospace industry; Pharmacia & Upjohn Caribe, Inc., in the pharmaceuticals industry; and IBM and Motorola Austin in the electronic equipment industry. A complete listing of all 2001 reporters is provided in Appendix B, Table B1.[3]

Most reporters indicated that their projects were affiliated with one or more government-sponsored voluntary programs. Of the 1,705 projects reported for 2001, 1,041 were affiliated with the Climate Challenge Program, 108 with the Landfill Methane Outreach Program, 57 with the Climate Wise Recognition Program, 37 with the U.S. Initiative on Joint Implementation, 33 with various Energy Star programs (including Energy Star Buildings, Energy Star Computers, and Energy Star Transformers), 17 with the Green Lights Program, 16 with the Natural Gas STAR Program, 9 with the Sulfur Hexafluoride Emissions Reduction Partnership, 9 with the Coalbed Methane Outreach Program, 7 with Compressed Air Challenge, and 6 with WasteWise. Other voluntary programs cited included the Voluntary Aluminum Industrial Partnership, Motor Challenge, Rebuild America, and Steam Challenge. Not all participants in the various voluntary programs provided information to the Voluntary Reporting Program.

Figure 1. Electric Power Sector and Other Entities Submitting Reports to the Voluntary Reporting of Greenhouse Gases Program, Data Years 1994-2001



(R) = revised.

Notes: Electric power sector includes electric utilities and independent power producers. 2000 data year includes 14 late reports that were not included in the totals presented in last year's annual report and database.

Source: Energy Information Administration, Forms EIA-1605 and EIA-1605EZ.

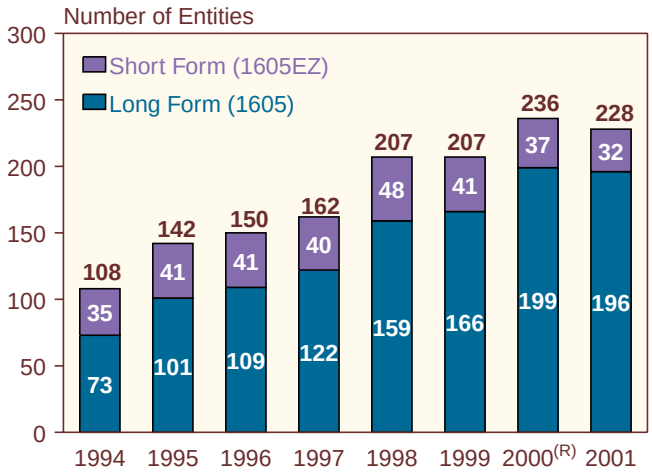
What Was Reported?

The Voluntary Reporting Program permits three distinct types of reporting:

- Project-level emissions and reductions, defined as the emission reduction consequences of a particular action
- Entity-level emissions and reductions, defined as the emissions and reductions of an entire organization, usually defined as a corporation
- Commitments to take action to reduce emissions in the future.

Of the 228 reports received, 196 (86 percent) were submitted on Form EIA-1605 (Figure 2). The remainder were submitted on Form EIA-1605EZ (the short form), which permits reporting on project-level reductions and sequestration only. The proportion of reporters using the short form has declined from 32 percent in the first year of the program (1994 data year) to 14 percent in the 2001 data reporting cycle. EIA believes that reporters are choosing the long form in order to document their emission reductions more thoroughly. Also, for the same reason several voluntary programs, such as the Landfill

Figure 2. Number of Reports Received by Form Type, Data Years 1994-2001



(R) = revised.

Note: 2000 data year includes 14 late reports that were not included in the totals presented in last year's annual report and database.

Source: Energy Information Administration, Forms EIA-1605 and EIA-1605EZ.

[3]Appendixes for this report are available from web site www.eia.doe.gov/oiaf/1605/vrrpt/index.html.

Methane Outreach Program, require or encourage participants to use the long form.

Most reporters (179 or 79 percent of nonconfidential reporters) reported project-level reductions, and 109 reported entity-level emissions and/or reductions. As these numbers imply, most (61) of the reporters that reported entity-level emissions or reductions also reported at the project level. One hundred eighteen organizations submitted only project-level reports, whereas 48 reported only entity-level information. Eighty-five reporters provided information on their commitments to reduce emissions or increase sequestration in the future.

Sources of greenhouse gas emissions and emission reductions reported to the Voluntary Reporting of Greenhouse Gases Program are characterized as direct, indirect, or unspecified. The unspecified category includes carbon sequestration reported on the long form and all reductions and sequestration reported on the short form. Because of concern about possible double counting (see box on page 6), EIA does not aggregate reported emissions or emission reductions across the three categories.

Project Level

Reporters provided information on a total of 1,705 projects for 2001 (Table 2). Most of these projects (1,495 or 88 percent) were reported on the long form. The total number of projects reported decreased by 384, or 18 percent, compared with the previous reporting cycle.[4] Most of the 1,705 projects reported for 2001 were also among the 2,089 projects reported for 2000, because they continued to yield emission reductions. Projects often yield emission reductions over an extended period of time; for example, an availability improvement project at a nuclear power plant typically involves the adoption of new maintenance and refueling programs that, once in place, are followed over a multi-year period. A project may even involve no new activity. The reforestation of an area in one year can result in the sequestration of carbon in many subsequent years, even if no additional trees are planted. Reporters continue to report the annual emission reductions and carbon sequestration achieved by such long-lived projects on a yearly basis.

Most projects involve actions within the United States; however, some are conducted in foreign countries, designed to test various concepts of joint implementation with other nations (Table 3). Fifty-eight of the 89 foreign projects represent shares in two forestry programs in Belize and Malaysia sponsored by the electric utility industry.

The principal objective of the majority of projects reported for 2001 was to reduce carbon dioxide emissions (Table 2). Most of these projects reduced carbon

Table 2. Distribution of Projects by Reduction Objective, Project Type, and Form Type, Data Year 2001

Reduction Objective and Project Type	Number of Projects			Number of Reporters		
	Long Form	Short Form	Total	Long Form	Short Form	Total
Reducing Carbon Dioxide Emissions	**841**	**146**	**987**	**132**	**36**	**168**
Electricity Generation, Transmission, and Distribution	373	50	423	72	23	95
Cogeneration and Waste Heat Recovery	18	0	18	11	0	11
Energy End Use	329	64	393	66	18	84
Transportation and Offroad Vehicles	53	13	66	31	6	37
Other Projects	68	19	87	40	9	49
Reducing Methane and Nitrous Oxide Emissions	**246**	**47**	**293**	**74**	**6**	**80**
Waste Treatment and Disposal (Methane)	208	45	253	54	4	58
Agriculture (Methane and Nitrous Oxide)	3	0	3	3	0	3
Oil and Natural Gas Systems and Coal Mining (Methane)	35	2	37	20	2	22
Carbon Sequestration	**369**	**14**	**383**	**51**	**12**	**63**
Halogenated Substances	**39**	**3**	**42**	**27**	**2**	**29**
Entity-Level Reporting Only (No Projects)	**NA**	**NA**	**NA**	**48**	**NA**	**48**
Commitment Reporting Only (No Projects or Entity-Level Data)	**NA**	**NA**	**NA**	**0**	**NA**	**0**
Total	**1,495**	**210**	**1,705**	**196**	**32**	**228**

NA = not applicable.

Notes: The total number of reporters is smaller than the sum of the number of reporters for each project type, because most reporters provided information on more than one project. Table excludes projects submitted in confidential reports.

Source: Energy Information Administration, Forms EIA-1605 and EIA-1605EZ.

[4]The total number of projects reported for 2000 has increased from 1,883 to 2,089 due to the receipt of 14 additional reports after the time the database used to prepare the annual report and Public Use Database for 2000 was finalized. See note to Table 3.

Double Reporting of Emission Reductions

Double reporting of emission reductions to the Voluntary Reporting of Greenhouse Gases Program can occur, because the ownership rights for such reductions may be claimed by more than one party. For example, both the manufacturers and owners of more efficient automobiles can claim emission reductions resulting from the operation of those vehicles (see page 18, "Who Owns the Reduction?"). Because the purpose of the Voluntary Reporting Program is to encourage reporting, EIA does not prohibit double reporting; however, EIA does endeavor to identify instances where double reporting may occur.

Reporters are required to distinguish between direct and indirect emissions and emission reductions on Form EIA-1605. Direct emissions are releases of greenhouse gases from sources owned (wholly or in part) or leased by the reporting entity. Indirect emissions are emissions from sources not owned or leased by the reporter that occur as a result of the reporter's activities. The most important indirect emissions are those associated with the consumption of electricity purchased from an electricity generator. Because the distinction between direct and indirect is unambiguous, direct emission reductions reported to the Program should include no double reporting.

The reporting forms do not currently allow the reporter to indicate whether carbon sequestered through forestry projects is direct (occurring on land owned by the reporter) or indirect (occurring on land owned by others). Also, Form EIA-1605EZ does not distinguish between direct and indirect reductions. EIA intends to address these issues in future modifications of its reporting forms. To put this issue in perspective, of total project-level emission reductions for 2001, 70 percent (222 million metric tons carbon dioxide equivalent) are reported as direct emission reductions, 23 percent (71 million metric tons carbon dioxide equivalent) are reported as indirect emission reductions, and 7 percent (23 million metric tons carbon dioxide equivalent) are unspecified, reported as sequestration on the long form or as reductions or sequestration on the short form.

A second mechanism to identify possible double reporting is to require reporters using the long form to identify any other entity or entities that participate in a project reported to the Program. This captures situations where more than one entity is responsible for creating the emission reduction, such as landfill gas projects where the landfill owner, the owner of the power plant that uses the landfill gas, and the purchaser of the resulting power all can, and often do, report all the effects of the project. In the case of the landfill operator, for example, the methane captured at the landfill would be reported as a direct emission reduction, and the possible reduction in central-station fossil fuel power generation would be reported as an indirect emission. In contrast, the operator of the power plant could claim the emission reduction at the power plant as a direct reduction and the reduction in methane emissions at the landfill as an indirect reduction. In general, EIA believes that instances of double reporting of direct emissions are very rare if not nonexistent; however, double counting can be an issue for indirect reductions, because their ownership is not as unambiguous.

Because of the concern that double reporting could result in double counting of emission reductions, EIA has discontinued reporting the direct, indirect, and unspecified reductions reported to the Program, in order to avoid giving the impression that the totals represent the cumulative effects of U.S.-sponsored projects on worldwide emissions of greenhouse gases. Emissions, emission reductions, and sequestration are disaggregated into the following categories: direct, indirect, and unspecified reductions and sequestration. Unspecified reductions and sequestration include sequestration reported on Form EIA-1605 and reductions and sequestration reported on Form EIA-1605EZ. As in the past, EIA does not combine reductions reported at the project level with those reported at the entity level, because the reported reductions represent the results of different approaches to estimating changes in greenhouse gas emissions.

EIA does not verify greenhouse gas emission reductions reported by participants, nor does it grant a property right associated with the claimed reductions. EIA does, however, conduct a four-step desk review to see that the data submissions are comprehensive, arithmetically accurate, internally consistent, plausible, and consistent with Program guidelines. The four steps of the desk review are (1) an analyst's review, (2) electronic edit checks incorporated into the reporting software to screen for errors, (3) manual checks of the methodologies employed, and (4) followup with reporters as needed to clarify any other issues. The Program requires the participants themselves to certify that the information reported is accurate to the best of their knowledge and belief; thus, the reporters are ultimately responsible for the accuracy of the reports submitted to the Voluntary Reporting Program.

dioxide either by reducing fossil fuel consumption or by switching to lower emitting sources of energy. Many also achieved small reductions in emissions of other gases. A total of 900 projects involved either efficiency improvements and switching to lower emitting energy sources in the electric power industry or energy end use measures affecting stationary or mobile combustion sources. Projects that also primarily reduced carbon dioxide emissions included the 87 "other" emission reduction projects, most of which involved either the reuse of fly ash as a cement substitute in concrete or the recycling of waste materials.

Projects that primarily affected carbon dioxide emissions accounted for reported direct reductions of 187 million metric tons carbon dioxide equivalent, representing 84 percent of the total direct reductions reported for 2001 on a carbon dioxide equivalent basis (Table 4). In addition, indirect reductions totaling 31 million metric tons carbon dioxide equivalent were also reported for the projects that reduced carbon dioxide emissions. A further 11 million metric tons carbon dioxide equivalent of unspecified reductions were reported on the short form, where the reporter is not asked to specify whether reductions or sequestration are direct or indirect.

Almost all of the 383 carbon sequestration projects reported on either the long form or the short form increased the amount of carbon stored in sinks through various forestry measures, including afforestation, reforestation, urban forestry, forest preservation, and modified forest management techniques. These activities accounted for 22 percent of the projects reported for 2001; however, 243 of the reported carbon sequestration projects represented shares in 9 projects conducted by the UtiliTree Carbon Company reported by 27 participating electric utilities. The sequestration reported for carbon sequestration projects for 2001 totaled 8 million metric tons of carbon dioxide on the long form and 9,088 metric tons of carbon dioxide on the short form. Direct emission reductions totaling 1,114 metric tons of carbon dioxide were also reported for a few projects where changes in forest management practices reduced fuel consumption.

A variety of efforts to reduce emissions of gases with high global warming potentials (GWPs) were also reported (see box on page 9). Two hundred ninety-three of the reported projects (17 percent) reduced methane and nitrous oxide emissions from waste management systems, animal husbandry operations, oil and gas systems, or coal mines. The 38 million metric tons carbon dioxide equivalent of direct methane reductions reported were offset by reported increases in carbon dioxide and nitrous oxide emissions totaling 10 million metric tons carbon dioxide equivalent. The carbon dioxide equivalent of the net reduction in direct emissions for projects that reduced methane and nitrous oxide emissions was 29 million metric tons, which represents 13 percent of the total direct reductions reported for 2001. Indirect reductions reported for projects that reduced methane and nitrous oxide emissions totaled

Table 3. Geographic Scope of Reports Received and Location of Emission Reduction Projects, Data Years 1994-2001

	Reports Received					Projects Reported			
	U.S. Only					U.S. Only			
Year	Long Form	Short Form	Foreign Only	Both U.S. and Foreign	Total[a]	Long Form	Short Form	Foreign Only	Total[a]
1994	65	34	2	4	**108**	500	125	9	**634**
1995	82	40	2	16	**142**	760	164	36	**960**
1996	83	41	1	24	**150**	828	179	33	**1,040**
1997	90	40	1	31	**162**	1,017	201	70	**1,288**
1998	118	47	1	40	**207**	1,212	252	85	**1,549**
1998	125	39	4	37	**207**	1,397	237	87	**1,721**
2000(R) . .	153	36	1	45	**236**	1,761	229	99	**2,089**
2001	153	32	1	41	**228**	1,405	210	90	**1,705**

[a]Totals are greater than the sum of the components because the latter exclude information from confidential reports.
(R) = revised
Notes: The number of report received for 2000 was revised to reflect the receipt of 14 reports after the finalization of the Public Use Database for last year's annual report. For 2000, additional reports were received from Branson Ultrasonics Corporation; CDX Gas, Inc.; City Utilities of Springfield; DuPont Company; Eaton Corporation – Commercial Controls Division; GeoMet, Inc.; Kansas City Power & Light Company; Naval Air Engineering Station Lakehurst; Pratt & Whitney, Middletown; Rochester Gas and Electric Corporation; Sikorsky Aircraft Corporation; Tacoma Public Utilities; Vermont Yankee Nuclear Power Corp.; and Waste Management, Inc. The number of projects reported for 2000 has also been revised to reflect the projects included in those reports. Table excludes projects submitted in confidential reports.
Source: Energy Information Administration, Forms EIA-1605 and EIA-1605EZ.

Table 4. Summary of Reported Project-Level Emission Reductions and Carbon Sequestration by Reduction Objective and Gas, Data Year 2001
(Metric Tons Carbon Dioxide Equivalent)

Gas	Reductions by Project Objective				Total Reductions
	Reduce Carbon Dioxide Emissions	Reduce Methane and Nitrous Oxide Emissions	Increase Carbon Sequestration	Reduce Emissions of Halogenated Substances	
Direct					
Carbon Dioxide	168,720,281	-9,703,805[a]	1,114	—	159,017,590
Methane	17,742,665	38,303,714	—	—	56,046,379
Nitrous Oxide	714,989	-3,357[a]	—	—	711,633
HFCs	—	—	—	—	0
PFCs	1,895	—	—	3,604,919	3,606,813
SF_6	—	—	—	2,475,144	2,475,144
Total Direct	**187,179,830**	**28,596,552**	**1,114**	**6,080,062**	**221,857,559**
Indirect					
Carbon Dioxide	31,245,606	16,383,708	—	—	47,629,315
Methane	115,719	23,100,478	—	—	23,216,197
Nitrous Oxide	65,146	89,419	—	—	154,566
HFCs	—	—	—	—	0
PFCs	34,319	—	—	—	34,319
SF_6	—	—	—	81	81
Total Indirect	**31,460,791**	**39,573,605**	**—**	**81**	**71,034,477**
Sequestration					
Carbon Dioxide	—	—	7,956,823	—	7,956,823
Methane	—	—	—	—	—
Nitrous Oxide	—	—	—	—	—
HFCs	—	—	—	—	—
PFCs	—	—	—	—	—
SF_6	—	—	—	—	—
Total Sequestration	**—**	**—**	**7,956,823**	**0**	**7,956,823**
Unspecified[b]					
Carbon Dioxide	10,832,093	13,866	9,088	—	10,855,046
Methane	19,596	3,940,752	—	—	3,960,348
Nitrous Oxide	—	—	—	—	—
HFCs	—	—	—	—	—
PFCs	—	—	—	4,046	4,046
SF_6	12,980	—	—	7,281	20,261
Total Unspecified	**10,864,669**	**3,954,618**	**9,088**	**11,327**	**14,839,701**

[a]Negative reductions represent increases in emissions.

[b]Unspecified emission reductions represent quantities reported on the short form (Form EIA-1605EZ), where reporters are not asked to distinguish between direct and indirect emission reductions or sequestration.

Notes: CFCs, HCFCs, and methyl chloroform are not included in the totals because of the uncertainty associated with estimates of net global warming potential for these gases. Their direct warming effects (radiative forcing) are offset by indirect cooling effects (destruction of stratospheric ozone, another greenhouse gas). Direct, indirect, and unspecified emission reductions and sequestration have not been totaled to avoid double counting of reductions or sequestration that have been reported by more than one entity.

Source: Energy Information Administration, Forms EIA-1605 and EIA-1605EZ.

40 million metric tons carbon dioxide equivalent, and unspecified reductions and sequestration reported on the short form contributed emission reductions equal to another 4 million metric tons carbon dioxide equivalent.

Forty-two projects reduced emissions of halogenated substances, including perfluorocarbons (PFCs) and sulfur hexafluoride (SF_6). Unlike previous years, no offsetting increases in emissions of hydrofluorocarbons (HFCs)—which are used as substitutes for chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs) being phased out under the Montreal Protocol—were reported for 2001. Direct reductions of PFC and SF_6 emissions totaled 6 million metric tons carbon dioxide equivalent, representing almost all the PFC and SF_6 emission reductions reported for 2001. Reductions of other gases, including carbon monoxide (CO), nonmethane volatile organic compounds (NMVOCs), CFCs, and HCFCs, were reported, but these gases do not have reliable GWPs and are not included in the carbon dioxide equivalent data presented in this report (see box below).

Direct emission reductions reported for 2001 increased by 5 percent over the reductions reported for 2000, to 222 million metric tons carbon dioxide equivalent (Table 5), and have more than tripled since the first year of the program (data year 1994). Reported direct reductions of carbon dioxide emissions increased by 10 percent, to 159 million metric tons carbon dioxide equivalent. Large increases in direct reductions of SF_6 and nitrous oxide were also reported for 2001. Reported direct reductions of SF_6 and nitrous oxide increased by 76 percent and 523 percent, respectively, over the levels reported for 2000. Reported reductions of indirect emissions increased by 14 percent, to 71 million metric tons carbon dioxide equivalent.

The sequestration reported peaked at 12 million metric tons for 1998 and has fallen below 10 million metric tons carbon dioxide for the two following years. This decline was caused by the decline in, or nonrecurrence of, sequestration reported for several large forest preservation initiatives. These projects avoided carbon releases associated with logging over the time period that the forests would have been harvested, which were reported as increased carbon sequestration over the same time period. Also, American Forests, which reported sequestration for 164 reforestation projects for 2000, did not submit a report for 2001. Unspecified reductions, which include reductions and sequestration reported on the

Comparison of Global Warming Potentials from the Second and Third Assessment Reports of the Intergovernmental Panel on Climate Change

Global warming potentials (GWPs) are used to compare the abilities of different greenhouse gases to trap heat in the atmosphere. GWPs are based on the radiative efficiency (heat-absorbing ability) of each gas relative to that of carbon dioxide (CO_2), as well as the decay rate of each gas (the amount removed from the atmosphere over a given number of years) relative to that of CO_2. The GWP provides a construct for converting emissions of various gases into a common measure, which allows climate analysts to aggregate the radiative impacts of various greenhouse gases into a uniform measure denominated in carbon or carbon dioxide equivalents.

The generally accepted authority on GWPs is the Intergovernmental Panel on Climate Change (IPCC). In 2001, the IPCC updated its estimates of GWPs for key greenhouse gases. The table at the right compares the GWPs published in 1996 in the IPCC's Second Assessment Report[a] and those published in 2001 in the IPCC's Third Assessment Report.[b]

Beginning with the information reported to the Voluntary reporting of Greenhouse Gases Program for 2000, EIA has used the IPCC's revised GWPs to calculate carbon dioxide equivalents in summarizing the results.

Comparison of 100-Year GWP Estimates from the IPCC's Second (1996) and Third (2001) Assessment Reports

Gas	1996 IPCC GWP	2001 IPCC GWP
Methane	21	23
Nitrous Oxide	310	296
HFC-23	11,700	12,000
HFC-125	2,800	3,400
HFC-134a	1,300	1,300
HFC-143a	3,800	4,300
HFC-152a	140	120
HFC-227ea	2,900	3,500
HFC-236fa	6,300	9,400
Perfluoromethane (CF_4)	6,500	5,700
Perfluoroethane (C_2F_6)	9,200	11,900
Sulfur Hexafluoride (SF_6)	23,900	22,200

[a]Intergovernmental Panel on Climate Change, *Climate Change 1995: The Science of Climate Change* (Cambridge, UK: Cambridge University Press, 1996).

[b]Intergovernmental Panel on Climate Change, *Climate Change 2001: The Scientific Basis. Summary for Policymakers* (Cambridge, UK: Cambridge University Press, 2001).

Table 5. Summary of Reported Project-Level Emission Reductions and Carbon Sequestration by Gas, Data Years 1994-2001
(Metric Tons Carbon Dioxide Equivalent)

Year	Carbon Dioxide	Methane	Nitrous Oxide	HFCs	PFCs	Sulfur Hexafluoride	Total
Direct							
1994 . . .	58,413,709	576,808	339,485	-29	3,199,649	83,579	**62,613,201**
1995 . . .	85,419,479	194,350	-438,673	-43	2,962,416	186,382	**88,323,910**
1996 . . .	77,601,577	9,411,042	-423,599	15,193	3,345,811	-69,985	**89,880,039**
1997 . . .	82,269,887	8,705,355	86,294	-42	3,318,600	516,732	**94,896,824**
1998 . . .	112,038,605	31,720,732	109,560	-1,738	3,504,380	624,786	**147,996,326**
1999 . . .	115,366,719	35,994,030	62,111	-1,738	3,425,480	595,379	**155,441,981**
2000(R) . .	144,096,233	61,945,794	114,198	—	3,233,612	1,407,347	**210,797,186**
2001 . . .	159,017,590	56,046,379	711,633	—	3,606,813	2,475,144	**221,857,559**
Indirect							
1994 . . .	2,994,405	2,360,734	2,243	—	—	—	**5,357,381**
1995 . . .	27,063,660	24,777,246	630,358	—	—	7,653	**52,478,917**
1996 . . .	26,207,709	26,612,114	616,075	—	—	—	**53,435,898**
1997 . . .	25,848,951	11,630,239	102,639	—	3,631	81	**37,585,541**
1998 . . .	27,968,865	15,152,664	105,598	—	6,068	81	**43,233,274**
1999 . . .	37,233,635	19,027,769	270,531	—	5,856	81	**56,537,872**
2000(R) . .	41,276,444	20,641,700	115,689	—	35,459	81	**62,069,372**
2001 . . .	47,629,315	23,216,197	154,566	—	34,319	81	**71,034,477**
Sequestration							
1994 . . .	746,545	—	—	—	—	—	**746,545**
1995 . . .	1,190,754	—	—	—	—	—	**1,190,754**
1996 . . .	8,676,591	—	—	—	—	—	**8,676,591**
1997 . . .	9,849,807	—	—	—	—	—	**9,849,807**
1998 . . .	12,490,927	—	—	—	—	—	**12,490,927**
1999 . . .	9,623,599	—	—	—	—	—	**9,623,599**
2000(R) . .	9,011,117	—	—	—	—	—	**9,011,117**
2001 . . .	7,956,823	—	—	—	—	—	**7,956,823**
Unspecified[a]							
1994 . . .	3,721,047	564,022	—	—	—	—	**4,285,069**
1995 . . .	4,959,366	1,162,752	—	—	—	—	**6,112,117**
1996 . . .	4,436,523	1,232,174	—	—	—	—	**5,668,697**
1997 . . .	6,688,175	1,825,383	—	—	123,049	—	**8,636,607**
1998 . . .	16,499,427	2,918,818	—	—	—	—	**19,418,245**
1999 . . .	9,607,428	3,273,878	—	—	—	4,783	**12,886,089**
2000(R) . .	9,125,506	3,127,762	—	—	—	20,744	**12,274,012**
2001 . . .	10,855,046	3,960,348	—	—	4,046	20,261	**14,839,701**

(R) = revised.

[a]Unspecified emission reductions represent quantities reported on the short form (Form EIA-1605EZ), which does not distinguish between direct and indirect emission reductions or sequestration.

Notes: Reductions of CFCs, HCFCs, and methyl chloroform are not included in the totals because of the uncertainty associated with estimates of their net global warming potential. Their direct warming effects (positive radiative forcing) are offset by indirect cooling effects (destruction of stratospheric ozone, another greenhouse gas). Totals may not equal sum of components due to independent rounding. Direct, indirect, and unspecified emission reductions and sequestration have not been totaled, in order to avoid double counting of reductions or sequestration that have may been reported by more than one entity. Negative reductions represent increases in emissions.

Source: Energy Information Administration, Forms EIA-1605 and EIA-1605EZ.

short form, increased to 15 million metric tons carbon dioxide equivalent in 2001.

Project-Level Reference Cases

Beginning with last year's annual report, EIA has begun dividing project-level data according to the reference case employed in calculating reported project-specific emission reductions. A "reference case" is an emissions or sequestration level against which actual emissions are compared to estimate emission reductions. In a "basic" reference case, actual historical emissions (or sequestration) in a specific year, or an average of a range of years, are used as the reference case. In a "modified" reference case, an estimate is made of what emissions or sequestration would have been in the absence of the project, and that estimate serves as the reference case.

The use of modified reference cases was reported for estimating reductions for 90 percent of the projects reported for 2001 on Form EIA-1605 (Table 6). A modified reference case is generally preferred for project-level analysis, because this approach attempts to isolate the effect of the action taken by the reporter from other factors that may have affected the reporter's emissions since the action was taken. The use of basic reference cases for 2001 was greatest for projects that reported reducing emissions of halogenated substances (56 percent of those projects), because the techniques for evaluating reductions for the projects are particularly suited to the use of a basic reference case. Emissions are determined using inventory management data, with emissions of a particular substance being equal to the amount purchased during the year to replace quantities emitted. Reductions can be calculated by subtracting the emissions in the years after emission abatement measures have been instituted from the emissions in the year before the measures were instituted.

In terms of emission reductions and sequestration reported for 2001, 184 million metric tons carbon dioxide equivalent of direct emissions (83 percent of total direct reductions), 60 million metric tons carbon dioxide equivalent of indirect emissions (84 percent of total indirect reductions), and 7 million metric tons carbon dioxide equivalent of sequestration (93 percent of total sequestration reductions) were reported as having been estimated using modified reference cases (Table 7). The project type categories where significant proportions of the reported direct reductions were estimated using basic reference cases were halogenated substances (90 percent) and transportation (81 percent). In addition, 55 percent of the reported indirect reductions for electricity generation transmission and distribution projects were calculated using basic reference cases, because several electric utilities reported nuclear-power-related projects that resulted in large reductions in power purchases and used basic reference cases to calculate the resulting indirect emission reductions.

Table 6. Number of Projects Reported on Form EIA-1605 by Reduction Objective, Project Type, and Reference Case Employed, Data Year 2001
(Number of Projects)

Reduction Objective and Project Type	Type of Reference Case				Total Number of Projects
	Modified		Basic		
	Number of Projects	Percent	Number of Projects	Percent	
Reducing Carbon Dioxide Emissions	**737**	**88**	**102**	**12**	**839**
Electricity Generation, Transmission, and Distribution	335	90	37	10	372
Cogeneration and Waste Heat Recovery	18	100	0	0	18
Energy End Use	279	85	50	15	329
Transportation and Offroad Vehicles	48	91	5	9	53
Other Projects	57	85	10	15	67
Reducing Methane and Nitrous Oxide Emissions	**239**	**97**	**7**	**3**	**246**
Waste Treatment and Disposal (Methane)	203	98	5	2	208
Agriculture (Methane and Nitrous Oxide)	3	100	0	0	3
Oil and Natural Gas Systems and Coal Mining (Methane)	33	94	2	6	35
Carbon Sequestration	**347**	**94**	**22**	**6**	**369**
Halogenated Substances	**17**	**44**	**22**	**56**	**39**
Total	**1,340**	**90**	**153**	**10**	**1,493**

Notes: Excludes projects reported on the short form (Form EIA-1605EZ), which does not collect information on the reference case employed. Excludes two projects reported on the long form (Form EIA-1605) for which no reference case was specified because reductions were not estimated. Excludes projects submitted in confidential reports.
Source: Energy Information Administration, Forms EIA-1605.

Entity Level

Most of the 109 reporters providing entity-level information included data on emissions as well as emission reductions or sequestration. Three reporters provided entity-level data on emissions only, and another five reporters provided entity-level data on emission reductions or sequestration only.

Total entity-level direct emissions of carbon dioxide reported for 2001 were 877 million metric tons, which represents a 15-percent increase from the 1,029 million metric tons reported for 2000. Reported direct emissions of other gases, including methane, nitrous oxide, HFCs, PFCs, and SF_6, totaled 26.2 million metric tons carbon dioxide equivalent for 2001. Total entity-level direct emissions of these gases reported for 2001 were 33 percent lower than those reported for 2000. Total direct and indirect emissions reported at the entity level for each data year from 1994 to 2000 are summarized in Table 8.

Total direct emission reductions reported at the entity level have declined by 18 percent this year, from 206.7 million metric tons carbon dioxide equivalent for 2000 to 169.2 million metric tons carbon dioxide equivalent for 2001. In 2001, 104.9 million metric tons carbon dioxide equivalent (62 percent) of the reported direct reductions were estimated using modified reference cases, and 38 percent were estimated with basic reference cases.

Reported entity-level indirect emission reductions for 2001 totaled 28.4 million metric tons carbon dioxide equivalent. Reported indirect reductions of 35.7 million metric tons carbon dioxide equivalent calculated with modified reference cases were offset by -7.3 million metric tons carbon dioxide equivalent of indirect reductions (i.e., net emission increase) calculated with basic reference cases. Entity-level sequestration reported for 2001 totaled 7.5 million metric tons carbon dioxide equivalent, the same as the total reported for 2000.

Commitments

Eighty-five entities reported formal commitments to reduce future emissions, to take action to reduce emissions in the future, or to provide financial support for activities related to greenhouse gas reductions.[5] More than one-third (34 percent) of these entities are electricity generators participating in the Climate Challenge Program (Figure 3). Other voluntary programs represented among the commitments reported for 2001 included Climate Wise, the Voluntary Aluminum Industrial Program, the U.S. Initiative on Joint Implementation, the Green Lights Program, the Landfill Methane Outreach Program, the Coalbed Methane Outreach Program, Motor Challenge, and the Sulfur Hexafluoride Emissions Reduction Partnership for Electric Power Systems.

Table 7. Reported Emission Reductions and Sequestration for Projects Reported on Form EIA-1605 by Reduction Objective, Project Type, Source, and Reference Case Employed, Data Year 2001
(Metric Tons Carbon Dioxide Equivalent)

Reduction Objective and Project Type	Direct Reductions		Indirect Reductions		Sequestration	
	Modified	Basic	Modified	Basic	Modified	Basic
Reducing Carbon Dioxide Emissions	**154,982,618**	**32,197,213**	**21,770,401**	**9,690,390**	**0**	**0**
Electricity Generation, Transmission, and Distribution	115,529,789	31,540,675	7,490,690	8,996,412	0	0
Cogeneration and Waste Heat Recovery	2,596,231	0	1,120,865	0	0	0
Energy End Use	18,819,086	620,054	7,466,440	134,316	0	0
Transportation and Offroad Vehicles	8,511	36,484	86,152	1,871	0	0
Other Projects	18,029,000	0	5,606,255	557,790	0	0
Reducing Methane and Nitrous Oxide Emissions	**28,184,515**	**412,038**	**38,125,541**	**1,448,065**	**0**	**0**
Waste Treatment and Disposal (Methane)	13,065,760	401,981	38,084,338	1,448,065	0	0
Agriculture (Methane and Nitrous Oxide)	148	0	22,478	0	0	0
Oil and Natural Gas Systems and Coal Mining (Methane)	15,118,607	10,057	18,724	0	0	0
Carbon Sequestration	**1,114**	**0**	**0**	**0**	**7,423,920**	**532,904**
Halogenated Substances	**631,268**	**5,448,794**	**81**	**0**	**0**	**0**
Total	**183,799,514**	**38,058,045**	**59,896,022**	**11,138,454**	**7,423,920**	**532,904**

Note: Excludes reductions and sequestration for projects reported on the short form (Form EIA-1605EZ), which does not collect information on the reference case employed. Excludes projects submitted in confidential reports.
Source: Energy Information Administration, Form EIA-1605.

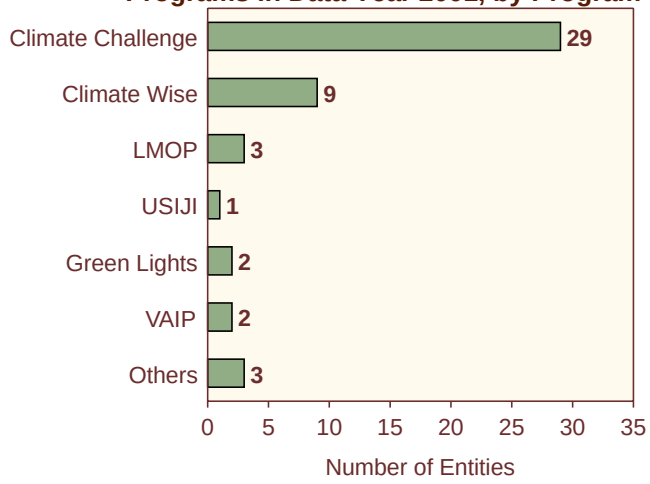
[5]Fifty companies reported formal commitments in one or more of the entity-level, project-level, or financial categories accommodated by Form EIA-1605. Thirty-five companies provided descriptions of future activities only in the Additional Information section of Schedule IV.

There are three forms of future commitment in the Voluntary Reporting Program: entity commitments, financial commitments, and project commitments. Entity and project commitments roughly parallel the entity and project aspects of emissions reporting: an entity commitment is a commitment to reduce the emissions of an entire organization; a project commitment is a commitment to take a particular action that will have the effect of reducing the reporter's emissions through a specific project. A financial commitment is a pledge to spend a particular sum of money on activities related to emission reductions, without a specific promise as to the emissions consequences of the expenditure.

Twenty-five firms made 32 specific promises to reduce, avoid, or sequester future emissions at the entity level. Some of these entity-level commitments were to reduce emissions below a specific baseline, others to limit the growth of emissions per unit of output, and others to limit emissions by a specific amount relative to a baseline emissions growth trend. In their reports for 2001, companies committed to reducing future entity-level emissions by a total of 94.4 million metric tons carbon dioxide equivalent. Almost one-half (44 percent) of entity-level emission reduction commitments were for the year 2000, with an additional 31 percent falling within the 2001 to 2005 time horizon.

Twenty-nine companies reported on commitments to undertake 182 individual emission reduction projects. Some of the commitments were linked to future results from projects already underway and forming part of the reporters' submissions. Others were for projects not yet begun. Reporters indicated that the projects were expected to reduce future emissions by 151 million metric tons carbon dioxide equivalent, most of which (90 million metric tons carbon dioxide equivalent, or 60 percent) would be reductions of methane. Twenty-one firms made financial commitments. The total amount of funds promised was $51.2 million, of which $7.1 million was reported to have been expended in 2001.

Figure 3. Number of Entities Reporting Commitments Associated with Voluntary Programs in Data Year 2001, by Program



Notes: LMOP = Landfill Methane Outreach Program, USIJI = United States Initiative on Joint Implementation, VAIP = Voluntary Aluminum Industry Partnership. Others include Coalbed Methane Outreach Program, Cool Communities Program, Motor Challenge Program, and Sulfur Hexafluoride Emissions Reduction Partnership for Electric Power Systems. The sum of entities reporting commitments associated with each program exceeds the total number of entities reporting commitments because several entities reported commitments associated with more than one program.

Source: Energy Information Administration, Form EIA-1605.

Table 8. Number of Entities Reporting at the Entity Level, Reported Emissions by Source, Emission Reductions by Source and Type of Reference Case Employed, and Sequestration, Data Years 1994-2001

(Million Metric Tons Carbon Dioxide Equivalent)

Year	Number of Entities Reporting	Emissions		Emission Reductions by Type of Reference Case						Sequestration
				Direct			Indirect			
		Direct	Indirect	Modified	Basic	Total	Modified	Basic	Total	
1994	39	752.7	494.9	38.2	22.6	60.8	1.6	1.2	2.8	0.5
1995	50	875.8	499.6	56.0	39.3	95.3	46.0	2.7	48.6	0.8
1996	55	1,183.1	461.5	65.4	44.6	110.0	42.9	5.7	48.6	7.9
1997	60	1,006.6	525.8	73.7	20.3	94.0	24.8	3.4	28.2	7.1
1998	76	1,110.7	473.5	105.8	22.6	128.4	28.3	13.2	41.6	11.2
1999	83	967.9	481.0	114.7	35.3	150.0	30.3	8.4	38.7	8.4
2000(R) . .	109	1,068.2	111.7	123.6	83.0	206.7	34.8	-7.8	27.0	7.5
2001	109	902.9	146.7	104.9	64.3	169.2	35.7	-7.3	28.4	7.5

(R) = revised.

Notes: 2000 data year includes late reports that were not included in the number of entities submitting 2000 data reports in time to be included in last year's annual report and database. Negative reductions represent increases in emissions.

Source: Energy Information Administration, Form EIA-1605.

Status of Policy Initiatives

Several policy initiatives were introduced in the United States over the past year to address the issue of global climate change. In 2002, the White House announced the Global Climate Change Initiative, the Department of Energy began work on the development of an enhanced 1605(b) Voluntary Reporting of Greenhouse Gases Program, the Congress worked to enact new, comprehensive energy legislation, and States and other organizations continued to develop innovative greenhouse gas registry and trading programs. The developments described here occurred in 2002 and would not have affected the reported emissions and emission reductions data for activities in 2001 discussed in this report; however, each of these policy efforts may play a significant role in the future development of the enhanced Voluntary Reporting of Greenhouse Gases Program.

U.S. Climate Change Initiative

On February 14, 2002, President George W. Bush announced the Administration's Global Climate Change Initiative, which includes new emission intensity reduction goals, incentives for clean technology development, added support for scientific research, expanded collaboration with foreign governments on climate change, and the development of a framework for the enhancement of the Voluntary Reporting of Greenhouse Gases Program.

A primary goal of the Global Climate Change Initiative is to slow the growth rate of greenhouse gas emissions while sustaining economic growth, using market mechanisms and energy technology development. In the proposal, the President established a national goal of reducing the greenhouse gas intensity of the U.S. economy by 18 percent over the next 10 years. Emissions intensity is a measure of the ratio of greenhouse gas emissions to economic output (gross domestic product). To achieve the goal, the Initiative focuses on fossil fuel energy conservation, methane recovery, and carbon sequestration in the short term and development of advanced energy technologies in the longer term.

Key domestic and international elements of the Global Climate Change Initiative include:

- **Domestic climate change initiatives:**
  - Enhancement of the 1605(b) Voluntary Reporting of Greenhouse Gases Program
  - Significantly expanded funding for basic scientific research and advanced technology development
  - Tax incentives, such as credits for renewable energy, cogeneration, and new technology
  - Challenges for business to undertake voluntary initiatives and commit to greenhouse gas intensity goals, such as through recent agreements with the semiconductor and aluminum industries
  - Transportation programs, including technology research and development and fuel economy standards
  - Carbon sequestration programs, which include increased funding for U.S. Department of Agriculture conservation programs under the Farm Bill to enhance the natural storage of carbon, promote the development of targeted incentives for forestry and agriculture projects to increase carbon sequestration, and establish accounting rules and guidelines for crediting sequestration projects
- **International climate change initiatives:**
  - Investments in climate observation systems in developing countries
  - Funding for "debt-for-nature" forest conservation programs
  - Use of economic incentives to encourage developing countries to participate in climate change initiatives
  - Expanding technology transfer and capacity building in the developing world
  - Joint research with Japan, Italy, and Central America.

The Global Climate Change Initiative includes a future progress check: the U.S. Government, in 2012, will evaluate whether its greenhouse gas emissions reduction progress is sufficient and whether scientific understanding at that time will justify further action. If further action is deemed necessary, the Initiative proposes to accelerate technology development and deployment using additional market-based mechanisms, voluntary measures, and incentive programs.

Enhanced 1605(b) Voluntary Emissions Reduction Registry

Pursuant to a key objective of the Global Climate Change Initiative, the Department of Energy is working to improve and expand the 1605(b) Voluntary Reporting of Greenhouse Gases Program. The primary goal is to create a credible and transparent program to report real reductions that support the national greenhouse gas intensity goal. In addition, the enhanced 1605(b) Program will allow businesses and individuals to record their reductions and ensure that those reporters are not penalized under a future climate policy. The objective of improving the registry and providing transferable credits for reductions is to help motivate firms to take cost-effective, voluntary actions to reduce greenhouse gas emissions, which would, in part, aid in the achievement of the Global Climate Change Initiative greenhouse gas intensity goal.

Since February 2002, when the President announced the new initiative, an interagency working group has undertaken several actions to improve the Voluntary reporting Program, including outreach efforts, solicitation of public comments, and review of the existing program. On July 8, 2002, the Secretary of Energy, joined by the Secretary of Commerce, the Secretary of Agriculture, and the EPA Administrator, submitted recommendations to the White House that will guide the process over the coming months to improve and expand the Voluntary Reporting Program.

Specifically, the Secretaries and Administrator recommended the following improvements:

- Develop fair, objective, and practical methods for reporting baselines, reporting boundaries, calculating real results, and awarding transferable credits for actions that lead to real reductions
- Standardize widely accepted, transparent accounting methods
- Support independent verification of registry reports
- Encourage reporters to report greenhouse gas intensity (emissions per unit of output) as well as emissions or emission reductions
- Encourage corporate or entity-wide reporting
- Provide credits for actions to remove carbon dioxide from the atmosphere (e.g., sequestration activities) as well as for actions to reduce emissions
- Develop a process for evaluating the extent to which past reductions may qualify for credits
- Ensure that the Voluntary Reporting Program will be an effective tool to assist in reaching the goal of an 18-percent reduction in greenhouse gas intensity
- Factor in international strategies as well as State-level efforts
- Minimize transactions costs for reporters and administrative costs for the Government, where possible, without compromising the recommendations above.

The recommendations highlight the need to create standardized, widely accepted, transparent accounting methods, support independent verification of registry reports, and ensure that companies that make real reductions are awarded credit under a future climate change policy. The Secretaries and the Administrator proposed a process, to culminate in new guidelines by January 2004 (for reporting 2003 data), that includes: several stakeholder workshops; sufficient time to update technical guidelines based on analysis and workshops; public comment periods to review the revised guidelines; and development of reporting forms, software, and a public-use database.

Federal Legislation on Voluntary Greenhouse Gas Reporting

An effort to pass the Energy Policy Act of 2002 ended in November at the close of the 107th Congress because of differences on many issues in the bill, including electric power industry restructuring, corporate average fuel economy (CAFE) standards, drilling in the Arctic National Wildlife Refuge, and mandated use of alternative fuels. The 108th Congress is expected to revisit the energy policy issues in 2003.

The Energy Policy Act of 2002 called for the establishment of a national greenhouse gas inventory, reductions registry, and database. The comprehensive energy bill, which had remained in conference from June through November, was the product of the House energy bill (H.R. 4) introduced in 2001 and amendments to include text from the Senate energy bill (S. 517) reintroduced by Senators Daschle and Bingaman in March 2002.

Title XI of the Energy Policy Act of 2002 contains the voluntary greenhouse gas reporting provisions that call for an enhanced Voluntary Reporting Program and incentives for emission reductions. Title XI text was taken from S. 517, because H.R. 4, as introduced in the House, did not contain any greenhouse gas registry provisions. In April 2002, before the Title XI language from the S. 517 was merged into H.R. 4, Representative Olver introduced H.R. 4611, "The National Greenhouse Gas Emissions Inventory Act of 2002," containing provisions that responded to the President's climate change proposal. Both S. 517 and H.R. 4611, using much of the same language, would have established greenhouse gas registries. Both bills would have required mandatory reporting for entities exceeding an emissions threshold to be determined (e.g., 10,000 metric tons carbon dioxide equivalent per year). In addition, both allowed voluntary reporting of emissions reductions but did not required third-party verification. One difference was that H.R. 4611 specified one of the purposes of the mandatory greenhouse gas inventory, registry, and information system as being to avoid penalizing early action to reduce emissions. S. 517 did not acknowledge this purpose.

Other U.S., State, and International Greenhouse Gas Registry Programs

Voluntary greenhouse gas emissions reporting programs and other State initiatives, such as emissions targets, emissions inventorying and monitoring, and emissions mitigation strategies, are gaining momentum as States investigate the most cost-effective policies to address climate change. California, New Hampshire, Wisconsin, New Jersey, Maine, Oregon, and the coordinated New England States and Canadian Provinces have each continued efforts to develop greenhouse gas

registry programs by enacting legislation and establishing rules and guidance. Highlights of Federal, State, regional, and other organizations' registry program activities in 2002 are presented below.

- ***President's Climate VISION.*** On February 12, 2003, the U.S. Department of Energy, on behalf of President Bush, launched the President's "Climate VISION" (Voluntary Innovative Sector Initiatives: Opportunities Now)—a voluntary public-private partnership to pursue cost-effective initiatives to reduce the projected growth in U.S. greenhouse gas emissions. Climate VISION, to be administered through the Department of Energy, is intended to help meet the President's goal of reducing U.S. greenhouse gas intensity—the ratio of emissions to economic output—by 18 percent by 2012. Climate VISION involves Federal agencies, including the Department of Energy, the U.S. Environmental Protection Agency, and the Departments of Agriculture and Transportation, working with industry partners to reduce greenhouse gas emissions voluntarily over the next decade. Industry groups making commitments include the Alliance of Automobile Manufacturers, Aluminum Association, American Chemistry Council, American Forest and Paper Association, American Iron and Steel Institute, American Petroleum Institute, American Public Power Association, Association of American Railroads, Business Roundtable, Edison Electric Institute, Electric Power Supply Association, Magnesium Coalition and International Magnesium Association, National Mining Association, National Rural Electric Cooperative Association, Nuclear Energy Institute, Portland Cement Association, and Semiconductor Industry Association.
- ***Climate Leaders.*** The EPA established Climate Leaders, a new voluntary industry-government partnership to encourage companies to establish clear greenhouse gas reduction targets and develop long-term comprehensive climate change strategies. In 2002, the EPA published several draft Greenhouse Gas Inventory Protocol documents and began soliciting public feedback.
- ***California.*** In 2002, the California Climate Action Registry, a voluntary program for reporting and registering greenhouse gas emissions occurring in or outside of the State of California, commenced operations. The California Registry issued reporting protocols and began enrolling members in October 2002. The California Registry requires third-party verification and seeks to protect participants' reported reductions under possible future regulatory programs.
- ***New Hampshire.*** New Hampshire recently promulgated rules to govern its Voluntary Greenhouse Gas Emissions Reductions Registry, based on legislation adopted in 1999. New Hampshire's program provides technical assistance to in-State participants in preparing greenhouse gas emissions reports.
- ***Wisconsin.*** Wisconsin continued to develop its greenhouse gas registry components during 2002, including a registry handbook, forms, and a web site.
- ***New Jersey.*** In 2002, New Jersey discontinued its multi-pollutant Open Market Emissions Trading (OMET) program. New Jersey had been the first State to take on a greenhouse gas reduction target and had initiated the development of a greenhouse gas registry to compliment the OMET program.
- ***Northeastern States.*** The six New England States and the Eastern Canadian Provinces have engaged in a joint effort to develop a regional greenhouse gas registry, as specified in the New England Governors and Eastern Canadian Premiers (NEG/ECP) Climate Change Action Plan. Separately, the New England States, plus New York and New Jersey, have also created an interstate association of air quality control divisions, titled the North East States for Coordinated Air Use Management (NESCAUM). NESCAUM supports the States, businesses, and environmental groups in the region with their development of registries, provides other technical assistance, and facilitates information exchange.
- ***Illinois, Iowa, New York, and Texas.*** These States have taken initial steps in developing State-level registries. For example, early in 2002, Texas authorities issued recommendations related to greenhouse gas reduction incentives for the State of Texas, to include the development of a greenhouse gas registry. Texas currently operates an Emissions Banking and Trading Program to facilitate compliance with Federal and State multi-pollutant air quality standards.
- ***Oregon.*** Oregon established the Oregon Climate Trust to facilitate the development and implementation of offset projects mandated under the State's carbon dioxide standard, a 1997 law that capped carbon dioxide emissions from power plants. In 2002, the Trust completed its first five offset project contracts, which began in 1999, and the Trust is currently finalizing contracts for seven projects to offset emissions from two State power projects. The Trust also has expanded the Greenhouse Gas Partnership Program to allow any organization to offset its emissions.
- ***WRI/WBCSD Greenhouse Gas Protocol Initiative.*** The World Resources Institute (WRI) and the World Business Council for Sustainable Development (WBCSD) Greenhouse Gas Protocol initiative is not a formal reporting program but an international program for developing accounting and reporting standards for greenhouse gas emissions and reductions that can be adopted by other reporting programs and registries. The corporate protocol is designed for entity-level reporting, but a project module is currently under development.

Accounting Issues for Voluntary Reporting and Beyond

The Voluntary Reporting of Greenhouse Gases Program was designed primarily to serve as a mechanism by which entities could report voluntary actions intended to reduce greenhouse gas emissions and sequester carbon.[6] EIA has the responsibility, among other things, for establishing and maintaining a database of reported greenhouse reductions that also serves as a national registry of reported reductions. While the information in the database may be used by the reporting entity to demonstrate achieved reductions of greenhouse gases, the program was not designed to support credit for early reductions or emissions trading programs. The program guidelines did not attempt to resolve the issues that arise in constructing the required reporting rules that would create a set of comparable, verifiable, auditable emission and reduction reports. Such rules would also be required for the flexible mechanisms, such as the Clean Development Mechanism, Activities Implemented Jointly, and Joint Implementation, included in the United Nations Framework Convention on Climate Change and its Kyoto Protocol.

The current Voluntary Reporting of Greenhouse Gases Program allows reporters considerable flexibility in the scope and content of their reports. As a result, companies can report their emissions and reductions in several different ways, and potentially more than one reporter can claim the same reduction. Some commentators on the program have characterized this aspect as a defect: a problem needing a solution. A more restrictive program, however, could limit the number of entities reporting, as well as the types of activities reported. Therefore, because it tends to increase participation in voluntary reporting, flexibility can be viewed as a useful attribute of the program for the following reasons:

- The educational and public recognition aspects of the program are enhanced by maximizing the participation and do not necessarily require a complete and fully-defined system of property rights to a reported emission reduction.
- The Voluntary Reporting Program can be viewed as a survey of emission accounting methods and theories actually in use, and a set of illustrations of the potential accounting and baseline problems that must be confronted in designing future policy instruments. A more structured approach might have been less useful for identifying and analyzing these emissions accounting issues.
- The Voluntary Reporting database illustrates the range and diversity of concrete actions that firms can undertake to limit greenhouse gas emissions, including many not imagined by the designers of the program. A more structured approach might have excluded some of the more original and innovative projects reported to the program.

These features make the program useful in evaluating the design and consequences of any proposed credit for early action program as well as the Kyoto Protocol's flexible mechanisms. By creating a database of real-world emission reduction actions and actors, the data reported to the Voluntary Reporting Program can be used to gain insight into the incentive effects and beneficiaries of various credit for early action and related proposals. The Voluntary Reporting of Greenhouse Gases database has provided a mechanism for identifying some of the issues that would have to be resolved in developing an accounting system for quantifying emissions, emission reductions, and sequestration. Such an accounting system will have to answer the following questions:

- Who can report?
- What is a reduction?
- Who owns the reduction?
- Would the reduction have happened anyway?
- How does one verify reports?

Who Can Report?

Section 1605(b) of the Energy Policy Act of 1992 mentioned only "entities" and "persons" as prospective reporters. Several overlapping concepts of "who can report" surfaced at the public hearings for the guidelines for the Voluntary Reporting Program, all of which were accommodated. These included:

- **A legal person: i.e., an individual, household, corporation, or trade association.** In this approach, emissions and reductions are calculated and reported for the entire entity.
- **A facility or group of facilities.** Emissions and reductions are calculated as those of a particular facility, defined as a single plant in a specified location, or perhaps even a single stack within a plant. A corporation or legal person acquires responsibility for emissions and reductions through ownership of one or more specified facilities.
- **A "project" or activity.** Reductions are defined by comparing the emissions from some set of sources deemed relevant with an estimate of what emissions would have been if a particular action or bundle of actions had not been undertaken.

[6]This discussion of accounting issues is based on testimony given by Jay Hakes, former EIA Administrator, on March 30, 2000, before the Senate Committee on Energy and Natural Resources on Senate Bills S. 882 and S. 1776 and their potential impacts on EIA's Programs. The full text of the testimony is available on EIA's web site at www.eia.doe.gov/neic/speeches/hrtest3-30-00/testimony3.htm.

What is a Reduction?

Perhaps the most intuitive definition of a reduction is one measured against an historical baseline, which represents the use of a "basic reference case." In this approach, the reduction is defined as the difference between the emissions of an entity or facility in a prior, baseline year, usually 1990, and in the current year. This approach is best suited to reporters whose activities have not appreciably changed since the baseline year. It presents particular problems for firms that have participated in mergers, acquisitions, or divestitures, or have made significant changes in the composition of their business. Startup companies or new facilities that have no history cannot use historical baselines. The historical baseline approach is also not well suited to measuring the reductions achieved by projects, because projects are often entirely new activities with no history.

Alternatively, many reporters define their reductions by comparison with what would have happened in the absence of a specified set of actions. Thus, corporate emissions may have risen, but they are less than they would have been in the absence of corporate action. This approach is called, in the Voluntary Reporting Program, a "modified reference case" or a "hypothetical baseline." It is important to point out, however, that a hypothetical baseline is a best guess of what would have happened in the absence of a project, and there is no way *per se* to prove or disprove it. Most of the projects reported to the Voluntary Reporting Program use a hypothetical baseline to calculate emission reductions or sequestration.

The "unit of production" approach is a variant of the fixed historical baseline, where the reporter normalizes baseline emissions to reflect changes in production. If emissions per unit of output have declined, by comparison either with levels in a prior year or with what they would have been in the absence of some actions, then the reporter has a reduction. This approach works reasonably well for organizations that have a well-defined product that is homogeneous across companies and over time: for example, kilowatthours generated or sold, tons of steel, or barrels of crude oil. As products increase in complexity, this approach gradually breaks down. Tons of semiconductors, for example, is a meaningless measure of output.

The alternative measures of reductions have their advantages and disadvantages. Basic reference cases are objective and relatively easily verifiable. On the other hand, absolute reductions are often the product of circumstance rather than action, while modified reference cases (which are more difficult to verify) explicitly measure the results of actions. Unit-of-production reference cases are useful only in a limited number of cases, and they can combine some of the disadvantages of both basic and modified reference cases.

Who Owns the Reduction?

Two theories of emissions ownership coexist in the Voluntary Reporting Program. The most intuitive, and commonplace, is called "direct emissions" and "direct reductions." If a reporter owns or uses (e.g., leases) the emission source, that reporter owns the emission as well as any reductions from this source. The advantage of limiting ownership to direct emissions is that it generally prevents multiple ownership of the same emission or reduction. However, this approach excludes many important emission reduction methods, including all activities that tend to reduce electricity consumption, the activities of energy service companies, and the provision of energy-efficient or emission reducing capital goods.

The alternative theory of ownership is based on causation: if an organization causes an emission or reduction, it is responsible for that emission, even if it does not own the emission source. Emissions or reductions from sources not owned by the reporter are referred to as "indirect." The most important example of indirect emissions is those produced through the consumption of electricity. If entities reduce their consumption of electricity, they cause their electric utility to reduce its emissions. This approach permits reporting of any action that has an influence on national emissions. However, the concept of "causing an emission" is inherently more ambiguous than "owning the smoke stack," and in many cases more than one firm may credibly claim to have helped cause an emission reduction.

EIA requires that reporters using Form EIA-1605 explicitly identify all emissions and reductions as either direct or indirect so that potentially double-counted reductions can be identified.

Would the Reduction Have Happened Anyway?

This issue is often discussed in other contexts under the term "additionality." It has been suggested that many emission reduction projects do not represent "real" reductions, because they would have been undertaken "anyway" in the normal course of business; however, creating an operational definition of additionality is difficult, because the "normal course of business" is a hypothetical concept. For the purposes of voluntary reporting—which include publicizing the types of actions that limit national greenhouse gas emissions and providing recognition for the companies that undertake those actions voluntarily—determining the

additionality of projects is unnecessary. For the purposes of a credit for early reduction program, however, additionality is an issue that needs to be considered.

How Does One Verify Reports?

The Department of Energy decided not to require verification by an independent third party after considering this issue during the development of the guidelines for the Voluntary Reporting Program. However, reporters must certify the accuracy of their 1605(b) reports. Also, filing a false statement on a U.S. Government form is illegal. EIA reviews each report received for comprehensiveness, arithmetic accuracy, internal consistency, and plausibility and makes suggestions for improving the accuracy and clarity of reports; however, the reporter is ultimately responsible for the accuracy of any report submitted to the Voluntary Reporting Program.

In general, reports submitted to EIA are factually accurate. Meaningful verification of the accuracy of 1605(b) reporting would require putting in place common baselines and accounting standards that dictate what information should be included in 1605(b) reports and how estimates of greenhouse gas emissions and reductions and carbon sequestration should be calculated. For example, if the accounting treatment for indirect emissions from electricity purchases is undefined, then a particular set of facts about a reporter could result in two different estimates of emissions: one including electricity purchases and one excluding electricity purchases. A third-party verifier can verify the facts about the reporter but cannot determine whether or not indirect emissions from electricity purchases ought to be included and, consequently, cannot determine whether the total emissions reported are correct or not.

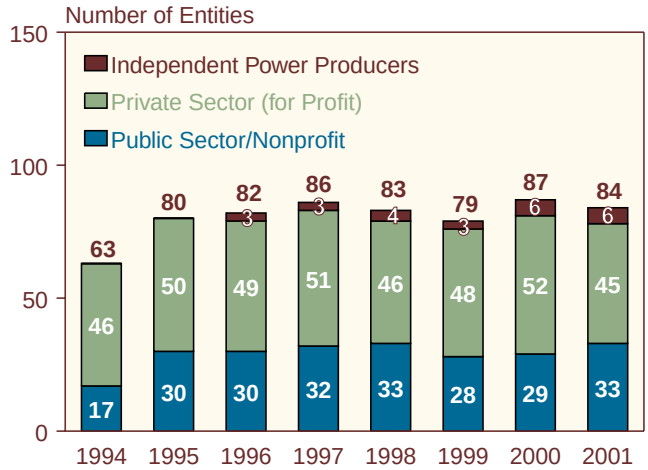
2. Reducing Emissions from Electric Power

Electric Power Industry

The electric power industry emitted approximately 2,243 million metric tons of carbon dioxide in 2001, 39 percent of total U.S. carbon dioxide emissions.[6] Carbon dioxide emissions result from the combustion of fossil fuels—coal, oil, and natural gas—during electricity generation. For example, coal, which accounted for 83 percent of electric power industry carbon dioxide emissions in 2001, is the primary energy source for U.S. electricity generation (providing 51 percent of total generation in 2001) and has the highest rate of carbon dioxide emissions per unit of energy used among fossil fuels.[7]

Since 1990, carbon dioxide emissions from the electric power industry have increased by 438 million metric tons or 23.7 percent, a trend that reflects U.S. economic growth (GDP grew by 37 percent between 1990 and 2001) and corresponding increases in fossil energy consumption in the electric power sector. In 2001, contrary to the upward movement in emissions since 1990, carbon dioxide emissions from the electric power industry decreased by 1.5 percent. Contributing to the decrease in emissions in 2001 was a 2.2-percent decrease in total electricity generation, a 2.6-percent decrease in coal-fired generation, and increases in the use of low-carbon fuels, including a 1.5-percent increase in natural-gas-fired generation and a 2-percent increase in nuclear generation.

Figure 4. Number of Electric Power Reporters Reporting on Form EIA-1605, by Entity Type, Data Years 1994-2001



Source: Energy Information Administration, Form EIA-1605.

Projects Reported

For the 2001 reporting year, a total of 84 electric power providers reported to the Voluntary Reporting Program on Form EIA-1605 (Figure 4). This is a decrease from the peak of 87 electric power providers reporting on the long form in 2000 but a 33-percent increase from the 63 reporters for the first reporting year, 1994. Since 1997, merger activity in the electric power industry as a result of deregulation has reduced the pool of electric utilities able to report to the Voluntary Reporting Program.[8]

Electric power providers make up 57 percent of the total 147 project-level reporters for data year 2001. Thirty-three of the electric power industry reporters were public sector or nonprofit organizations, including electric cooperatives, municipal utilities, and other public-sector entities such as the Tennessee Valley Authority (TVA). Forty-five entities were private-sector organizations, mostly investor-owned utilities (IOUs). Six independent power producers (IPPs) reported to the program for 2001, the same as the number reporting for 2000.

The 391 electric power projects reported for 2001 (Figure 5) represent a 10-percent decrease from the 2000 reporting year total of 434 but still a 106-percent increase from the 190 projects reported for 1994. Electric power projects were the most numerous project type reported to the Voluntary Reporting Program, accounting for 26 percent of all projects reported for 2001.

Electric power projects are reported in two categories: (1) carbon content reduction; and (2) increasing energy efficiency in generation, transmission, and distribution. Carbon content reduction projects include availability improvements, fuel switching, and increases in lower

[6]Energy Information Administration, *Emissions of Greenhouse Gases in the United States 2001*, DOE/EIA-0573(2001) (Washington, DC, December 2002), web site www.eia.doe.gov/oiaf/1605/1605a.html.

[7]Energy Information Administration, *Annual Energy Review 2001*, DOE/EIA-0384(2001) (Washington, DC, November 2002), web site www.eia.doe.gov/emeu/aer/.

[8]There were 141 operating electric utilities in the United States in 2000, compared with 172 in 1992. See Energy Information Administration, *The Changing Structure of the Electric Power Inudstry 2000: An Update*, DOE/EIA-0562(00) (Washington, DC, October 2000), web site www.eia.doe.gov/cneaf/electricity/chg_stru_update/update2000.html.

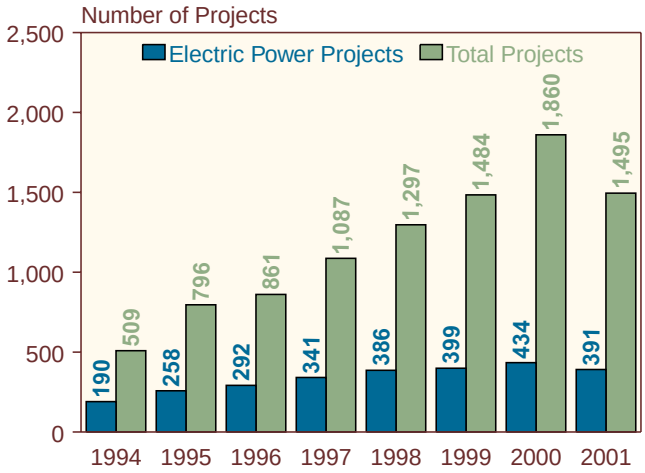
emitting capacity. Increased efficiency through generation, transmission, and distribution projects includes such activities as heat rate improvements, cogeneration and waste heat recovery, high-efficiency transformers, and reductions in line losses associated with electricity transmission and distribution. A total of 188 projects for increased energy efficiency in generation, transmission, and distribution were reported for 2001, and 225 carbon content reduction projects were reported.[9]

Reductions Reported

In 2001, total reported emission reductions from 391 electric power projects (Table 9) included 149.6 million metric tons carbon dioxide equivalent from direct sources and 17.6 million metric tons from indirect sources. The 225 projects in the category "reducing carbon content" reported emission reductions of 138.5 million metric tons carbon dioxide equivalent from direct sources and 15.2 million metric tons from indirect sources. The 188 projects included in the category "increasing energy efficiency in generation, transmission, and distribution" reported emission reductions of 14.3 million metric tons carbon dioxide equivalent from direct sources and 2.5 million metric tons from indirect sources.

Many of the largest projects reported to the Voluntary Reporting Program are electric power projects. In 2001, 31 electric power projects reported direct reductions of 1 million metric tons carbon dioxide equivalent or more, representing 79 percent of all the projects that reported direct emission reductions exceeding 1 million metric tons carbon dioxide equivalent. About three-quarters of the reported electric power projects were related to nuclear power.

Figure 5. Electric Power Projects and Total Projects Reported on Form EIA-1605, Data Years 1994-2001



Source: Energy Information Administration, Form EIA-1605.

Table 9. Number of Electric Power Projects and Emission Reductions Reported on Form EIA-1605 by Project Type and Reduction Type, Data Year 2001

Reduction Objective and Project Type	Number of Projects Reported	Emission Reductions Reported (Metric Tons Carbon Dioxide Equivalent)	
		Direct	Indirect
Reducing Carbon Content	**225**	**138,479,714**	**15,248,841**
Availability Improvements	38	76,187,246	9,136,880
Fuel Switching	49	5,136,203	270,409
Increases in Lower Emitting Capacity	105	60,287,612	6,678,455
Other Carbon Reductions	46	26,234,319	214,529
Increasing Energy Efficiency	**188**	**14,256,353**	**2,472,477**
Generation	*135*	*10,836,846*	*2,204,960*
Efficiency Improvements	117	8,240,615	1,084,096
Cogeneration and Waste Heat Recovery	18	2,596,231	1,120,865
Transmission and Distribution	*54*	*3,429,733*	*267,517*
High-Efficiency Transformers	26	1,381,868	225,971
Reconductoring	25	1,579,171	208,750
Distribution Voltage Upgrades	27	2,133,330	161,687
Other Transmission and Distribution	12	1,517,720	70,761
Total Electric Power Projects	**391**	**149,666,695**	**17,607,967**

Note: Project totals may not equal sum of components because some projects may be counted in more than one category.
Source: Energy Information Administration, Form EIA-1605.

[9]More than one project type may be assigned to a single project; therefore, the sums of the projects and reductions in many project type categories exceed the total numbers of projects and the total reductions reported.

Reducing the Carbon Content of Energy Sources

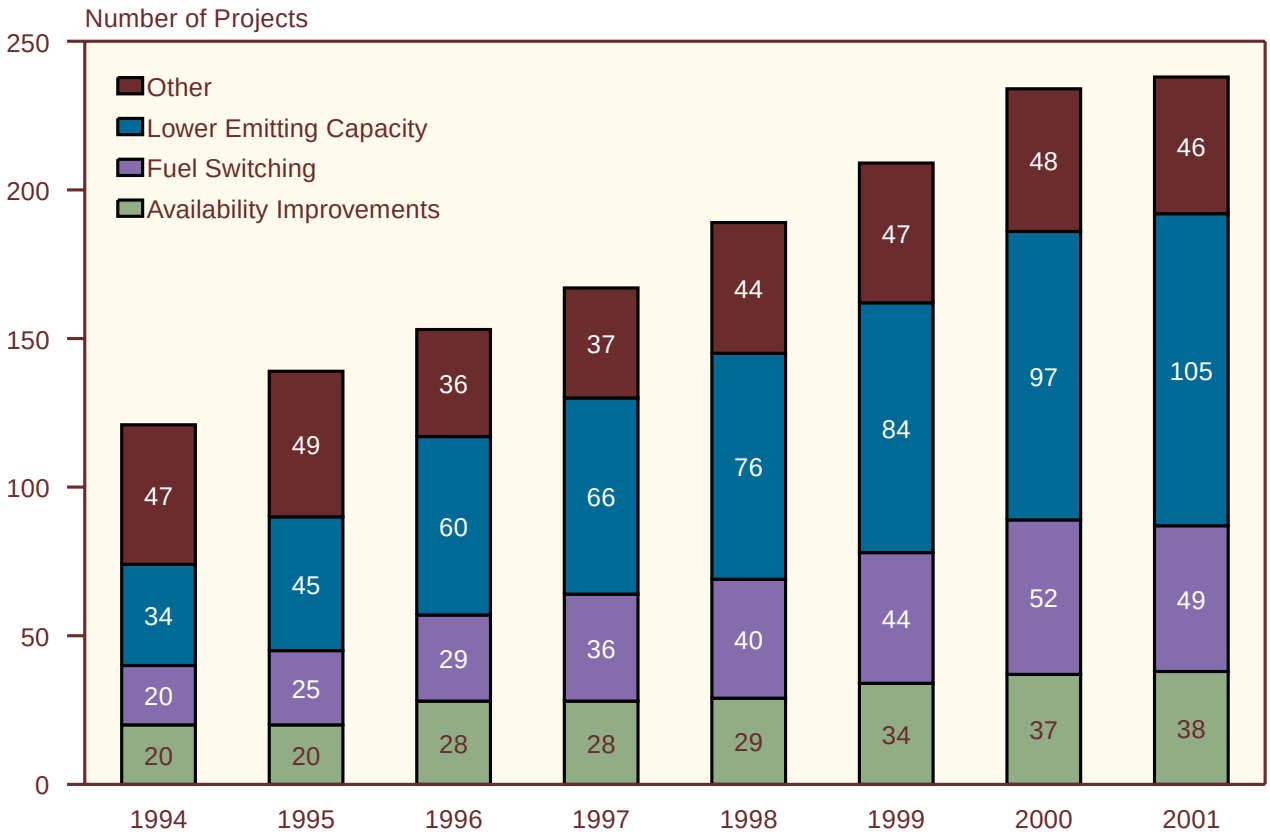
Projects involving fuel switching, power plant availability improvements, increases in low- or zero-emitting generation capacity, and other similar activities typically reduce the amount of carbon consumed to generate a unit of electricity. A total of 225 such projects were reported for 2001, including some of the largest projects reported to the Voluntary Reporting Program (Figure 6). The emission reductions reported for "carbon content reduction" electric power projects in 2001 totaled 138.5 million metric tons carbon dioxide equivalent from direct sources and 15.2 million metric tons from indirect sources. Some carbon content reduction projects are in fact "hybrids," combining efficiency improvements with measures such as availability improvements or increases in low-emitting capacity (see box on page 24).

Availability Improvements

By increasing generation from lower emitting power plants, availability improvement projects provide a commensurate reduction in the amount of generation supplied by higher emitting plants. The number of availability improvement projects reported for 2001 was 38—1 more than the 37 reported for 2000 and 18 more than the 20 reported for 1994. Availability improvement projects accounted for reported emission reductions in 2001 totaling 76.2 million metric tons carbon dioxide equivalent from direct sources and 9.1 million metric tons from indirect sources. As for previous reporting years, availability improvement projects, especially those undertaken at nuclear facilities, produced some of the largest reported reductions in carbon dioxide emissions. Of the 38 availability improvement projects reported, more than one-half involved nuclear power plants. Mainly through significant advances in operating, maintenance, and refueling procedures, capacity factors at nuclear plants were increased, displacing some fossil-fuel-based power generation.

Because nuclear power plants are invariably large baseload facilities, even a fairly small improvement in plant availability can lead to a sizable reduction in fossil fuel consumption. For example, Dominion Generation reported the project, "Increased Nuclear Generation at Surry Power Station," involving an increase in the total annual electrical output of the Surry Power Station for 2001 above the station's 1987-1990 baseline output. The increase, which resulted from an increase in the station's

Figure 6. Electric Power Projects Reported on Form EIA-1605 Reducing the Carbon Content of Energy Sources, by Project Type, Data Years 1994-2001



Note: The sum of projects in many project categories exceeds the total number of projects reported, because more than one project type may be assigned to a single project.

Source: Energy Information Administration, Form EIA-1605.

availability, meant that less electricity was generated at Dominion's coal-fired generating facilities. The net result was a reduction in Dominion's annual carbon dioxide emissions below what they would have been had Surry's output not increased. For 2001, Dominion reported a change of 6,364 gigawatthours of generation from bituminous coal to nuclear power for this project, directly reducing carbon dioxide emissions by 5.9 million metric tons.

Fuel Switching

Forty-nine fuel-switching projects were reported for 2001, 3 less than the 52 reported for 2000 and 29 more than the 20 reported for 1994. Switching from coal or oil to natural gas lowers carbon dioxide emissions because of the lower carbon content of natural gas relative to other fossil fuels. For example, switching from bituminous coal to natural gas can reduce carbon dioxide emissions per unit of energy consumed by approximately 43 percent. Although other reported actions, such as switching from oil to gas, may not lead to reductions of the same magnitude, they also reduce greenhouse gas emissions. The fuel-switching projects reported for 2001 accounted for emission reductions totaling 5.1 million metric tons carbon dioxide equivalent from direct sources and 0.3 million metric tons from indirect sources.

An example of a fuel-switching project is a phased gas expansion project to increase the use of natural gas as a fuel, reported by Florida Power & Light (FPL). FPL implemented steps in the early 1990s to significantly increase the availability of competitively priced natural gas supplies for future generating units. This was done at a time when FPL's integrated resource plan and fuel diversity strategies called for the construction of pulverized coal units. The expansion of FPL's natural gas supplies allowed the utility to construct two new state-of-the-art high-efficiency combustion turbine combined-cycle plants (the Lauderdale Repowering Project and the Martin Combined Cycle Project) in lieu of two 720-megawatt pulverized coal units originally considered. In addition, the innovative, first-of-a-kind repowering of the Lauderdale steam-electric plant allowed for the retirement of two old, inefficient 137-megawatt oil/gas utility boilers. In 2001 the project reportedly displaced 97 trillion Btu of residual fuel for an equal amount of natural gas at Ft. Lauderdale units 4 and 5 and Martin units 3 and 4, reducing carbon dioxide emissions by 2.6 million metric tons.

Increases in Lower Emitting Capacity

Projects involving the construction of new, lower emitting power plants or increases in the capacity of existing lower emitting plants were among the most numerous electricity supply projects reported. A total of 105 such projects were reported for 2001, up from 97 reported for 2000 and 34 for 1994. Most involved increases in nuclear (23 projects), hydropower (19 projects), photovoltaic (16 projects), and wind capacity (36 projects) and other system efficiency improvements—increasing the output of power sources with essentially no greenhouse gas emissions. Emission reductions reported for increases in

Electricity Supply Carbon Reduction Projects: Definitions and Terminology

The combustion of fossil fuels to produce heat for electricity generation causes greenhouse gas emissions. In addition to substantial releases of carbon dioxide, fossil fuel combustion also emits small quantities of methane and nitrous oxide. Carbon content reduction projects typically reduce greenhouse gas emissions by replacing higher emitting fuels (such as coal) with lower emitting fuels (such as natural gas) or non-emitting energy sources (such as nuclear power or renewables). Projects that reduce the carbon content of electricity supply include the following.

Availability Improvements. By reducing the frequency and length of planned and unplanned power plant outages, availability improvement projects can result in increased use of the affected plant. This is particularly true if the plant is a *baseload* plant (i.e., a plant that is generally used on an around-the-clock basis except during plant outages), but it may hold true for other types of plants as well. If the resulting increase in generation from the affected plant displaces generation that otherwise would have been produced by a higher emitting plant, emission reductions will result. Power plant utilization is measured by the plant's *capacity factor*, defined as the ratio of the average load on the plant over a given period to its total capacity. For example, if a 200-megawatt plant operates (on average) at 75 percent of its rated capacity (i.e., at a load of 150 megawatts) over a period of a year, the plant's capacity factor is 75 percent for that year.

Fuel Switching. The amount of carbon contained in fossil fuels and released in the form of carbon dioxide during combustion varies, depending on the type of fuel. Thus, carbon dioxide emissions from a power plant can be reduced by switching from a higher emitting fuel (such as coal) to a lower emitting fuel (such as natural gas).

Increases in Lower Emitting Capacity. By increasing the capacity of an existing lower emitting or non-emitting plant (e.g., a hydroelectric plant), or by constructing new generating capacity (e.g., wind turbines), a utility can reduce or avoid reliance on higher emitting plants. The result will be a reduction in greenhouse gas emissions from the displaced plants.

low-emitting capacity projects in 2001 totaled 60.3 million metric tons carbon dioxide equivalent from direct sources and 6.7 million metric tons from indirect sources.

Exelon Corporation began the Chicago Public School Solar Partnership in August 2000. The partnership started with Reilly Public School, and four schools are now participating. Each school has a 10.8-kilowatt solar array. Based on the assumption that 1 kilowatt produces approximately 1,487 kilowatthours annually in the Chicago area, the four systems collectively produced an estimated 64,238 kilowatthours in 2001, indirectly reducing carbon dioxide emissions by 47 metric tons, nitrous oxide emissions by 1.65 pounds, and methane emissions by 0.79 pounds. Although the reductions are small in comparison with other projects, the benefits of the partnership are to raise awareness and educate the public about alternative energy resources. The partnership conducts projects, seminars, demonstrations, and workshops. The benefits for the Chicago Public Schools are twofold: (1) on-site stationing of large numbers of photovoltaic systems whose costs are heavily, or sometimes completely, leveraged by outside parties; and (2) installation of energy systems that require minimal maintenance and can be worth thousands of dollars in annual electricity cost avoidance.

Other Carbon Reduction Projects

Forty-six "other carbon reduction" projects were reported for 2001, 2 less than reported for 2000 and 1 less than reported for 1994. This category of "other" projects includes projects that decrease high-emitting capacity, make dispatching changes only, or increase low- or zero-emitting capacity. In 2001, 26 projects used low- or zero-emitting power purchases to reduce emissions. This category was added to the Voluntary Reporting Program in 1999 to classify electric power producer/supplier purchases of power from low- or zero-emitting generation sources for resale, replacing generation or purchases of power from more carbon-intensive generation sources. Another 3 projects reported for 2001 involved decreases in higher emitting capacity, and 3 involved changes in the dispatching of power plants. Changes in dispatch order can reduce carbon dioxide emissions if lower emitting plants are used more frequently. For 2001, reported emission reductions from "other carbon reduction" projects totaled 26.2 million metric tons carbon dioxide equivalent from direct sources. An emissions increase of 0.2 million metric tons carbon dioxide equivalent was reported from indirect sources.

An example of a "dispatching changes only" project is the "Merger Dispatch Savings" project reported by Cinergy. Emission reductions were achieved through the economic dispatch of Cinergy's generating facilities. Before the merger of the Cincinnati Gas & Electric Company and PSI Energy, the same generating facilities were dispatched according to the demands of each operating company. After the merger, the units from both operating companies were operated and dispatched as if a single company owned them. This method of operation and economic dispatch is estimated to provide a 1-percent efficiency gain in the operation of the system. The efficiency gain is realized because the more recently built generating units are the most efficient units, and these are the first dispatched to meet customer demands for electricity. Therefore, the most efficient generating units are operating more than the older, less efficient units. In 2001, Cinergy reported a decrease in energy consumption of 253,374 short tons of bituminous coal and direct reductions of 566,757 metric tons of carbon dioxide emissions.

In another project reported for 2001, We Energies' Energy for Tomorrow™ renewable energy program allows customers to choose to have some or all of their energy come from renewable-based generation. The program began in June 1996 as a combination of underutilized wood waste and hydroelectric capacity from a neighboring utility. In 1997, local area hydropower suppliers were added. In 1999, We Energies installed two wind turbines to provide generating capacity for the program. Landfill gas generation from Waste Management of Wisconsin, Inc., was also added and is reported to the Voluntary Reporting Program. In 2001, landfill gas was used in the project to generate 24,905 megawatthours of electricity. Program participants' use of energy from renewable-based generation offsets generation at coal-fired facilities, which reduces emissions. We Energies reported on 25 percent of this project and filed it as a zero/low-emitting power purchase project and an increase in low-emitting capacity project. In 2001, We Energies reported changes in energy consumption that included a decrease of 8,456 megawatthours of electricity generated from coal as the result of increases of 2,500 megawatthours of generation from hydropower and 5,956 megawatthours from wind energy, directly reducing carbon dioxide emissions by 8,958 metric tons.

Increasing Energy Efficiency in Electricity Production and Distribution

Projects involving improvements in the efficiency of electricity generation, transmission, and distribution were more numerous than the other electric power projects reported for 2001 but produced smaller emission reductions on average. Efficiency improvement tends to be an ongoing effort by electricity suppliers, yielding a continuous stream of small, incremental improvements rather than one-time dramatic increases in efficiency. For example, heat rate improvement projects often are undertaken in response to normal plant deterioration. As power plants age, efficiency tends to erode gradually. Operators seek to maintain heat rates by replacing or refurbishing old, worn-out equipment. Similarly,

new energy-efficient transformers are often installed gradually over a period of years, as old transformers fail.

A total of 188 "increasing energy efficiency" projects were reported for 2001, including some hybrid projects that combined efficiency improvements with measures such as availability improvements. The efficiency improvement projects fall into two main categories: (1) generation, involving efficiency improvements in the conversion of fossil fuels and other energy sources into electricity; and (2) transmission and distribution, involving improvements in the delivery of electricity from the power plant to the end user (see box on page 28).

Generation Projects

Efficiency Improvements. Improvements in generating efficiency were the most numerous type of efficiency project reported for 2001. A total of 117 such projects were undertaken in 2001. Heat rate improvements at coal-fired power plants are a commonly reported means of increasing efficiency and reducing carbon dioxide emissions. There are numerous opportunities for improving efficiency at existing power plants, but the efficiency gains, and hence reductions in fuel consumption and emissions, are limited by technology and tend to be small. Emission reductions reported for generation efficiency improvement projects in 2001 totaled 8.2 million metric tons carbon dioxide equivalent from direct sources and 1.1 million metric tons from indirect sources.

FirstEnergy Corporation reported heat rate efficiency improvements on the Ohio Edison System that were accomplished through: (1) shutdown of less efficient coal-fired boilers, (2) installation of enhanced boiler controls, and (3) turbine modifications. With the shutdown of less efficient boilers, it is expected that the remaining boilers in the Ohio Edison System will meet the demand for electricity while requiring less fuel and, therefore, emitting less carbon dioxide. In 2001, this project reported a reduction of 8.6 trillion Btu in consumption of bituminous coal, resulting in direct reductions of 807,037 metric tons of carbon dioxide emissions. The carbon dioxide emission reduction estimates were based on existing operation data, such as heat content of fuel consumed (Btu) and total electricity produced (kilowatthours), which were used to derive the heat rate (Btu per kilowatthour). The reference case heat rate was the average of the baseline period from 1987 to 1990. Reduction in the heat rate is the difference between the reference case heat rate and the individual heat rate for 2001. The energy saved (Btu) due to heat rate improvement is the product of the total electricity produced and the improved heat differential for each of the subsequent years.

Entergy reported on general generator improvements with the project, "Louisiana Station 1 Repowering and Unit Upgrade." In late 1997, a major expansion at the Louisiana Station 1 was completed. The main elements of the expansion were the installation of a 150-megawatt gas combustion turbine with associated heat recovery steam generator, refurbishment of three boilers, and an upgrade of the existing gas turbine. The new combustion turbine increased thermal input by 1,473 million Btu per hour, but the reduction in operation of three boilers decreased thermal input by 909 million Btu per hour, and maintaining another boiler on cold standby reduced thermal input by 630 million Btu per hour; thus, the expansion resulted in a decrease in heat input of 66 million Btu per hour. In 2001, this project reported a reduction of 338,646 million Btu in consumption of natural gas, resulting in direct a reduction of 17,819 metric tons of carbon dioxide emissions.

Cogeneration and Waste Heat Recovery. A total of 18 cogeneration and waste heat recovery projects were reported for 2001, as compared with 4 projects reported for 1994. Emission reductions reported for cogeneration and waste heat recovery projects in 2000 were, on average, larger than those reported for any of the other types of efficiency improvement projects but less than the average for carbon content reduction projects. Industrial partners in the cogeneration projects reported for 2001 include a greenhouse, steel mills, and a heating plant in the Czech Republic. Reported end uses of the thermal energy include electricity generation, process heat applications, space heating and cooling, and cooking. The emission reductions reported for cogeneration and waste heat recovery projects in 2001 totaled 2.6 million metric tons carbon dioxide equivalent from direct sources and 1.1 million metric tons from indirect sources.

Minnesota Power reported on a new cogeneration project that began in June 2001. Minnesota Power installed, and is the operator of, Cloquet Energy Center Turbine Generator 5. The new unit, with approximately 23 megawatts net capacity, was placed in a process steam line where steam previously had been throttled to lower pressure for process use. Consequently, the electricity produced had an overall 83-percent process efficiency from steam produced from boilers fueled by 50 percent natural gas and 50 percent mill process wood waste (biomass). It was estimated that the cogeneration application heat rate was 4,112 Btu per net kilowatthour of electricity generation, displacing conventional generation fired by subbituminous coal. Minnesota Power owns and operates the turbine, providing payment to Sappi Limited (owner of the Cloquet paper mill) for steam when Minnesota Power produces electricity for the grid. In 2001, this project reported direct emission reductions of 55,134 metric tons carbon dioxide.

PEI Power reported a cogeneration project in which waste process heat was used for electricity generation,

industrial process heat, and heating, cooling, and ventilation. The PEI Power boiler is capable of firing landfill gas and pipeline natural gas. The unit is operated to burn landfill gas first and then use natural gas as a supplement. The boiler produces steam that is put through a steam turbine to produce electricity. After the steam goes through the three stages, the end product is then used to produce hot water for an adjacent greenhouse. Also, steam comes off the first extraction and goes to a plastic manufacturer for process use. In 2001, this project reported energy consumption of 760.1 billion Btu from landfill gas and 88.6 billion Btu from natural gas to generate 6.4 million kilowatthours of electricity, with corresponding direct emission reductions of 628 metric tons carbon dioxide and indirect emission reductions of 36,169 metric tons carbon dioxide.

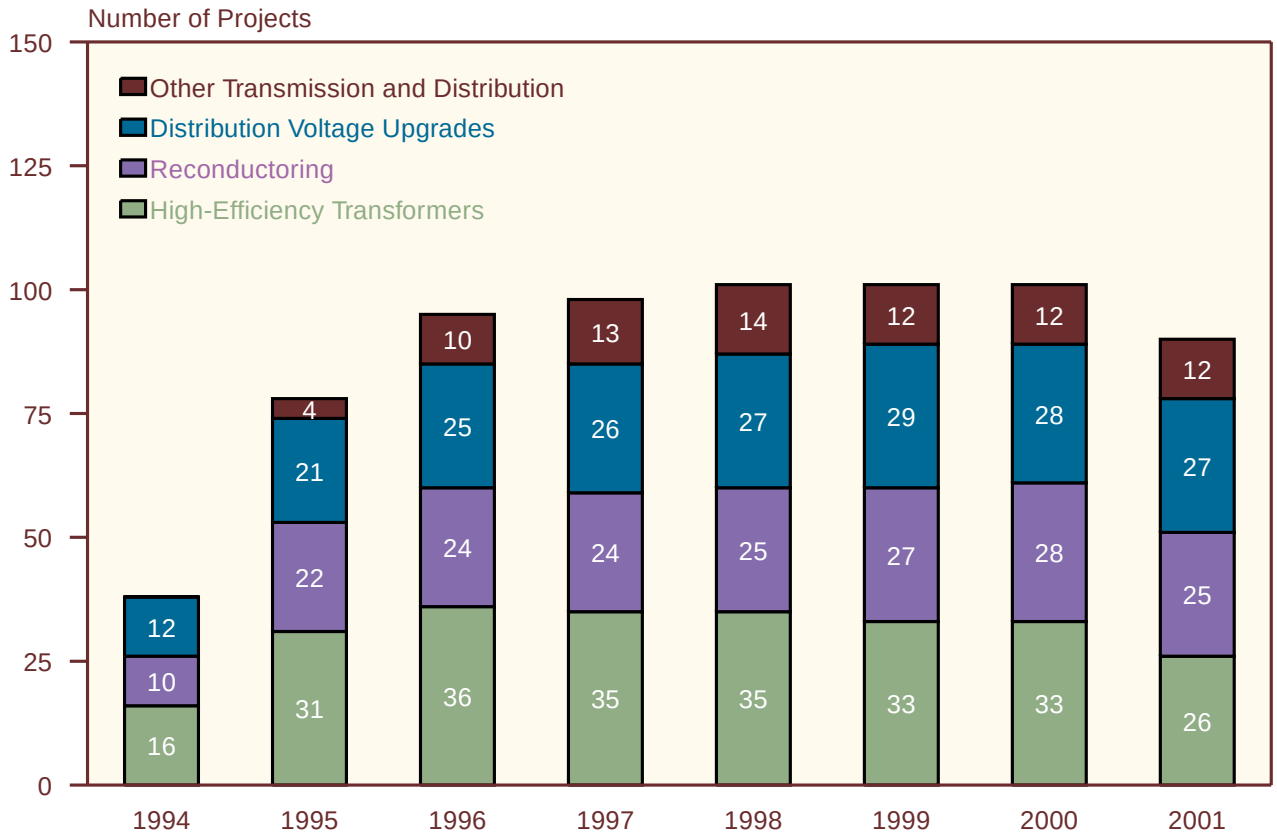
Transmission and Distribution Projects

Transmission and distribution projects, although not as numerous as generation projects, were nonetheless reported in significant numbers. For 2001, 54 transmission and distribution projects were reported. Unlike generation projects, which typically have discrete start and completion dates, efforts such as upgrading conductors and replacing transformers are ongoing activities by electric power producers. Consequently, most of the transmission and distribution efficiency improvements reported for 2001 were reported as continuations of long-standing projects rather than as new projects.

In terms of average emission reductions, transmission and distribution projects typically are somewhat smaller than generation projects. There are numerous opportunities for improving efficiencies in the delivery of electricity, but the magnitude of the efficiency gains that can be realized is limited.

For 2001, the most frequently reported types of transmission and distribution projects (Figure 7) were high-efficiency transformers (including improved silicon steel and amorphous core transformers); reconductoring (replacing existing conductors with large-diameter conductors to reduce line losses); and distribution voltage upgrades (increasing the voltage at which the various segments of the system operate to reduce line losses). The other transmission and distribution project category includes projects that involve more than one type of activity, as well as such activities as transmission line improvements and capacitor installations. A total of 26 high-efficiency transformer projects were reported

Figure 7. Reported Transmission and Distribution Projects Reported on Form EIA-1605 by Type, Data Years 1994-2001



Note: The sum of projects in many project categories exceeds the total number of projects reported, because more than one project type may be assigned to a single project.

Source: Energy Information Administration, Form EIA-1605.

for 2001, 7 less than the 33 reported for 2000 and 10 more than the 16 reported for 1994. Many of the reported projects were "hybrid" projects, combining high-efficiency transformer installation with one or more other transmission and distribution activities (e.g., reconductoring).

Another 25 projects involving reconductoring and 27 projects involving distribution voltage upgrades (again, often in combination with other activities) were reported for 2001, both lower than the numbers reported in the same categories for 2000. The reporters classified

Efficiency Projects: Definitions and Terminology

Generation Projects

It is neither theoretically nor practically possible to convert all the thermal or other energy produced in, or consumed by, a power plant into electrical energy. In fact, much of the energy is lost rather than converted. Typically, U.S. steam-electric generating plants operate at efficiencies of about 33 percent, meaning that two-thirds of the thermal energy produced is lost. Some more advanced power plants have higher efficiencies, but even new combined-cycle plants (in which the waste heat from a gas turbine is recovered to produce steam to drive a turbine) typically have efficiencies of only 50 to 60 percent. Generation projects seek to improve power plant efficiencies either by reducing the amount of energy lost during the conversion process or by recovering the lost energy for subsequent application.

Efficiency Improvements. By increasing the efficiency of the generation process, efficiency improvement projects at fossil-fuel-fired power plants reduce the plants' *heat rate*, defined as the amount of fossil energy (measured in Btu) needed to produce each kilowatthour of electricity. The result is a reduction in the amount of fuel that must be burned to meet generation requirements, and hence a reduction in carbon dioxide (and other greenhouse gas) emissions. Efficiency improvements at nonfossil (e.g., hydroelectric) power plants can also reduce greenhouse gas emissions. Emission reductions occur if the efficiency improvement leads to an increase in the amount of electricity generated by the affected plant, with a consequent reduction in the amount of electricity that must be generated by other (fossil fuel) plants to meet demand.

Cogeneration. Only a portion of the heat generated during the combustion of fossil fuels can be converted into electrical energy; the remainder is generally lost. Cogeneration involves the recovery of thermal energy for use in subsequent applications. Cogeneration facilities typically employ either topping or bottoming cycles. In a *topping cycle*, thermal energy is first used to produce electricity and then recovered for subsequent applications. Topping cycles are widely used in industry as well as utility power plants that sell electricity and steam to customers. In a *bottoming cycle*, the thermal energy is first used to provide process heat, from which waste heat is subsequently recovered to generate electricity. Bottoming cycle applications are less common, usually associated with high-temperature industrial processes. Because cogeneration involves the recovery and use of thermal energy that would otherwise be wasted, it reduces the amount of fossil fuel that must be burned to meet electrical and thermal energy requirements, hence reducing greenhouse gas emissions.

Transmission and Distribution Projects

The purpose of the electricity transmission and distribution system is to deliver electrical energy from the power plant to the end user. Resistance to the flow of electrical current in cables, transformers, and other components of the transmission and distribution system causes a portion of the energy (typically about 7 percent) to be lost in the form of heat. Improving the efficiency of the various system components can decrease such line losses, reducing the amount of generation required to meet end-use demand and, thus, power plant fossil fuel consumption and greenhouse gas emissions.

High-Efficiency Transformers. Transformers, used to change the voltage between different segments of the transmission and distribution system, are a source of system losses. Transformer losses occur as a result of impedance to the flow of current in the transformer windings and because of hysteresis and eddy currents in the steel core of the transformer. When existing transformers are replaced with high-efficiency transformers (including improved silicon steel transformers and amorphous core transformers), losses are reduced.

Reconductoring. Like transformers, conductors (including feeders and transmission lines) are a source of transmission and distribution system losses. In general, the smaller the diameter of the conductor, the greater its resistance to the flow of electric current and the greater the consequent line losses due to heating. Reconductoring involves the replacement of existing conductors with larger diameter conductors.

Distribution Voltage Upgrades. Line losses are dependent, in part, on the voltage at which the various segments of the transmission and distribution system operate. Upgrading the voltage of any segment can reduce line losses.

12 projects as "general" or "other" transmission and distribution, the same number as reported for 2000. Emission reductions reported for transmission and distribution projects in 2001 totaled 3.4 million metric tons carbon dioxide equivalent from direct sources and 0.3 million metric tons from indirect sources.

The Los Angeles Department of Water and Power (LADWP) reported a project to install energy-efficient transformers. A total of 1,857 transformers—both overhead and pad-mounted, with various loads and voltages—were in use as of May 2002. Total energy saving was calculated by multiplying energy saving per transformer by the quantity of each type of transformer. The average total energy saving was then multiplied by the total hours of operation per year to arrive at the annual energy saving. Carbon dioxide emission reductions were calculated by multiplying the annual energy saving by the LADWP's fossil-fueled power plant emission factor. In 2001, this project reported a decrease in electricity consumption of 1.4 gigawatthours and direct emission reductions of 1,064 metric tons carbon dioxide.

Kansas City Power & Light Company reported the installation of new transmission lines, reconductoring of old lines to improve efficiency, and a power flow management system. In 2001, this project reported a decrease in electricity consumption of 31,105 megawatthours and direct emission reductions of 34,398 metric tons carbon dioxide.

Seattle City Light reported a project on distribution voltage upgrades. The energy savings were derived from replacing 4-kilovolt unit substations and their attendant losses with the smaller losses of a 26-kilovolt system. Eliminating 4-kilovolt distribution feeders decreased distribution feeder losses, and installing larger capacity 26-kilovolt transformers reduced distribution (pole-top) transformer losses. Since 1992, this project has converted 32 substations and each 4-kilovolt substation eliminated represents a total savings of 5.5 kilowatthours per substation conversion. In 2001, the project reported a decrease in electricity generation of 1,542 megawatthours and indirect emission reductions of 605 metric tons carbon dioxide.

3. Reducing Emissions from Energy End Use

Introduction

Greenhouse gas emissions from energy end use include emissions from the industrial, commercial, residential, and transportation sectors. Transportation accounts for 1,876 million metric tons carbon dioxide, nearly all from mobile sources, and represents approximately 32 percent of U.S. carbon dioxide emissions. The industrial, commercial, and residential sectors combined generate the balance of U.S. carbon dioxide emissions, accounting for 3,839 million metric tons carbon dioxide, nearly all from stationary sources (Figure 8). Emissions from stationary sources are produced both directly by the combustion of fossil fuels (e.g., natural gas consumption for home heating) and indirectly from the consumption of electricity (e.g., for commercial lighting).

Reducing Emissions from Stationary Sources

Energy use at stationary sources in the industrial, commercial, and residential sectors accounted for emissions of 3,839 million metric tons carbon dioxide in 2001—two-thirds of total U.S. carbon dioxide emissions. Emissions from stationary sources included 2,243 million metric tons carbon dioxide from the generation of electricity that was ultimately consumed in these three sectors. Industry was responsible for the largest share of stationary-source emissions (29 percent), followed by the residential sector (20 percent) and the commercial sector (18 percent).

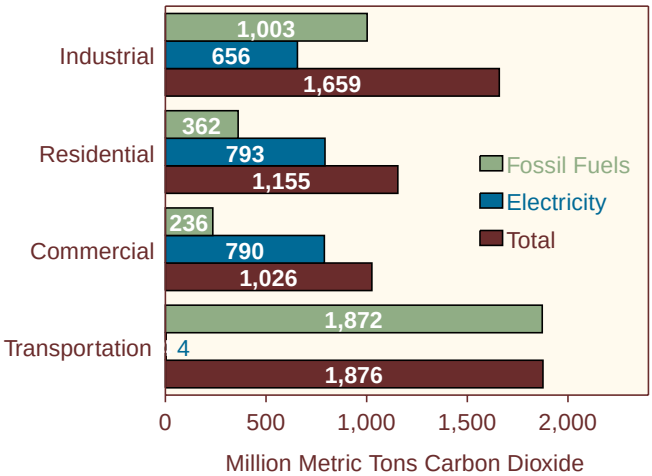
Between 1990 and 2001, carbon dioxide emissions associated with industrial, residential, and commercial energy use increased by 12.8 percent. The commercial sector is the fastest-growing emissions source, registering a 31.5-percent increase in emissions between 1990 and 2001. Emissions from the residential sector increased by 22.3 percent over the same period, while industrial sector emissions declined by 1.2 percent.[10]

Projects Reported

Reported emission reduction projects affecting stationary sources include fuel switching (e.g., from fuel oil to natural gas); light bulb replacement (e.g., substituting compact fluorescent bulbs for incandescents); heating, ventilation, and air conditioning (HVAC) system upgrades (e.g., maintenance or replacement with more efficient units); and appliance replacement (e.g., retiring old appliances for Energy Star products). For 2001, 66 entities reported 329 energy end-use projects on Form EIA-1605 (Table 10). These 329 projects accounted for 22 percent of all the projects reported on the long form, ranking third behind electricity supply (26 percent) and sequestration (25 percent). An additional 31 projects reported for 2001 involved coal ash reuse (see box on page 32).

Among the 66 entities that reported energy end-use projects for 2001 on Form EIA-1605, 74 percent were electric utilities, of which 21 were publicly owned and 28 were privately owned. Cement companies and manufacturers of automobiles and other transportation equipment were represented by 5 reporters (8 percent) each. Two pharmaceutical and health care product companies reported energy end-use projects for 2001 (3 percent). The remaining 8 percent of reporters was made up of 1 electronic and other electrical equipment company, 1 food and kindred products company, 1 holding and other investment offices, 1 primary metal manufacturer, and 1 private household.

Figure 8. Sources of U.S. Carbon Dioxide Emissions by Sector, 2001



Note: The industrial sector includes agriculture; the residential and commercial sectors exclude transportation.

Source: Energy Information Administration, *Emissions of Greenhouse Gases in the United States 2001*, DOE/EIA-0573(2001) (Washington, DC, December 2002).

[10]Energy Information Administration, *Emissions of Greenhouse Gases in the United States 2001*, DOE/EIA-0573(2001) (Washington, DC, December 2002), p. 21, web site www.eia.doe.gov/oiaf/1605/1605a.html.

Both the number of entities reporting and the number of energy end-use projects reported for 2001 were lower than those for 2000, as were the total reported direct and indirect emission reductions resulting from energy end-use projects (Table 10). Changes in funding sources for efficiency programs and the transition toward competition in the electricity supply industry may have contributed to the decline in the numbers of entities and projects reported for 2001. For example, EIA reports that some States are now funding demand-side management (DSM) activities through State agencies, such as the California Board for Energy Efficiency, the New York Energy Research and Development Authority, and Efficiency Vermont.[11]

Emission reductions reported for individual energy end-use projects ranged from less than 1 metric ton carbon dioxide equivalent to almost 4.5 million metric tons, primarily because of the flexibility allowed in defining the scope of a project. Some reporters include information on each individual end-use initiative separately, whereas others aggregate information on a range of activities in a single project. For example, an electric utility may report on a DSM project that achieves direct emission reductions through multiple supplemental approaches, such as encouraging their residential, commercial, and industrial customers to change light bulbs, temporally shift electric loads, implement urban forestry projects, and upgrade appliances, building shells, and HVAC systems.

Among projects for which direct emission reductions were reported for 2001, 86 percent had reductions of less than 100,000 metric tons carbon dioxide equivalent (Figure 9). Similarly, among projects for which indirect emission reductions were reported, 94 percent had

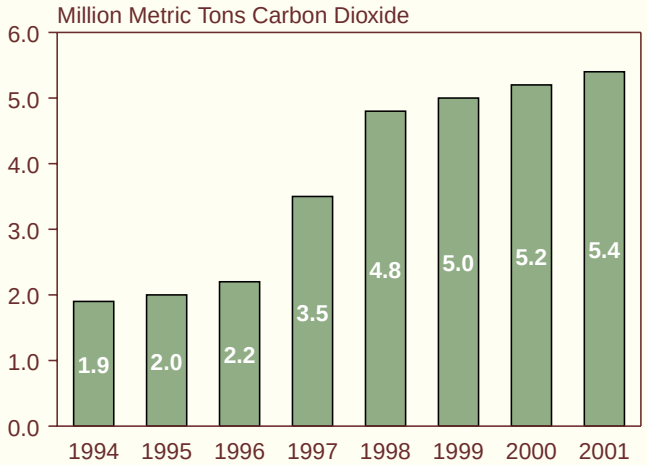
Coal Ash Reuse Projects

Coal ash, a byproduct of coal combustion, is a marketable commodity for the electric power sector, which accounts for 91 percent of coal use in the United States.[a] The most common use of coal ash is as a replacement for Portland cement in the manufacture of concrete, and reductions in carbon dioxide emissions are achieved by reducing emissions from the calcination process. Electric utilities sell coal ash produced at their facilities to avoid landfill disposal costs and to meet increasing demand for the commodity.

In 2001, the total number of entities reporting coal ash reuse projects (28) decreased slightly from the 34 entities reporting such projects in 2000. There was a corresponding decrease in the total number of projects reported for 2001 (31), down from 38 reported for 2000. The total carbon dioxide emission reductions reported increased by almost 3 percent, however, to 5.4 million metric tons (see figure). The combined indirect emission reductions reported for coal ash reuse projects in 2001 accounted for 7.6 percent of the indirect carbon dioxide emission reductions reported for all projects. Just over 7 million metric tons of coal ash was reported to have been reused in 2001, primarily as a substitute for Portland cement in concrete. A small assortment of reporters indicated that fly ash was reused in materials including road base, anti-skid material, or structural fill; however, emission reductions from these applications were not quantified. The largest quantities of coal ash reused were reported by TXU (917,264 metric tons), by American Electric Power (672,974 metric tons), and by Alliant Energy (567,907 metric tons).

Reporters used different emission coefficients to estimate their carbon dioxide reductions for cement substitution, ranging from 0.8 to 1.0 metric ton per ton of coal ash reused. The emissions avoided by using coal ash in concrete vary, depending on the fuels used to produce the thermal and electrical energy needed for manufacturing the displaced cement and the proportion of coal ash in the concrete. The largest individual carbon dioxide reductions from coal ash reuse were reported by the same three reporters: TXU (733,811 metric tons), Alliant Energy (567,907 metric tons), and American Electric Power (532,771 metric tons).

Indirect Emission Reductions from Coal Ash Reuse Projects Reported on Form EIA-1605, Data Years 1994-2001



Source: Energy Information Administration, Form EIA-1605.

[11] Energy Information Administration, "Electric Utility Demand-Side Management 2000" (January 2002), web site www.eia.doe.gov/cneaf/electricity/dsm00/dsm_sum.html.

Table 10. Number of Energy End-Use Reporters, Projects, and Emission Reductions Reported on Form EIA-1605, Data Years 1994-2001

Data Year	Number of Reporters	Number of Projects Reported	Emission Reductions Reported (Metric Tons Carbon Dioxide Equivalent)	
			Direct	Indirect
1994	51	160	9,103,753	1,318,092
1995	63	221	12,450,879	1,591,590
1996	62	214	15,288,497	1,538,196
1997	67	249	16,685,010	3,798,030
1998	79	308	18,282,751	5,026,424
1999	80	330	16,047,912	6,786,832
2000	77	382	19,663,333	8,155,193
2001	66	329	19,439,140	7,600,756

Notes: More than one project type may be assigned to a single project; therefore, the sums of the projects and reductions in each project type category may exceed the total numbers of projects and reductions in the totals and subtotals. Table excludes data from confidential reports.

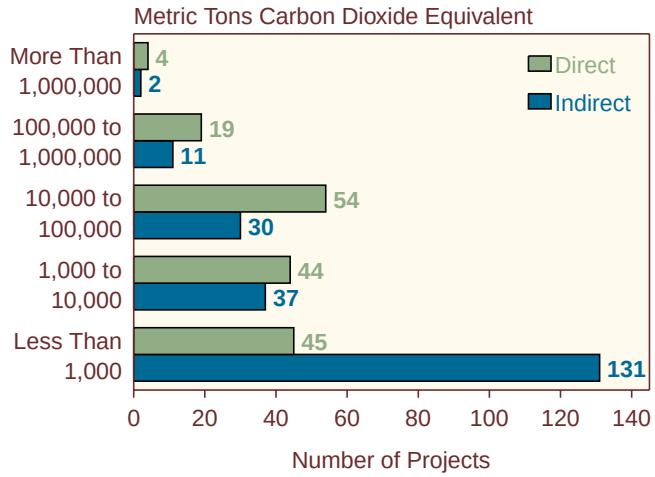
Source: Energy Information Administration, Form EIA-1605.

reductions of less than 100,000 metric tons carbon dioxide equivalent. Only six energy end-use projects reported emission reductions greater than 1 million metric tons each for 2001 (one fewer than for 2000).

The 10 largest projects reported in terms of emission reductions achieved in 2001 were aggregated electric utility DSM programs. DSM projects may focus on one or more load shape objectives (see box on page 34). Although the most common load shape objective of reported DSM projects was increased energy efficiency (310 projects), electric utilities also attempted to balance their load profiles with various other load shape objectives including peak clipping (62 projects), load shifting (33 projects), valley filling (17 projects), and load building (10 projects) (Figure 10).

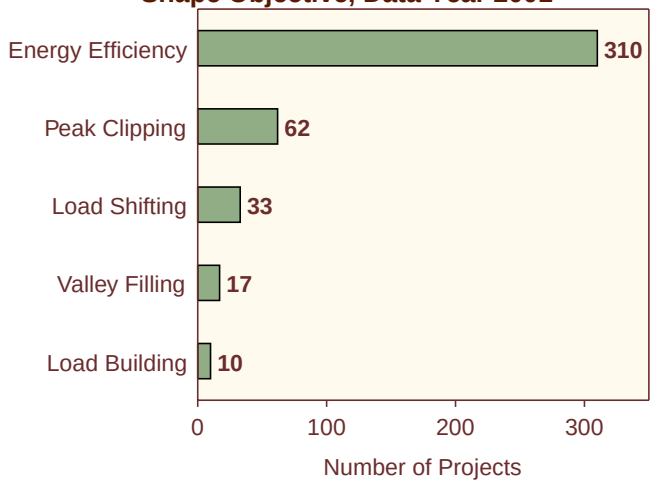
Energy end-use projects can be carried out anywhere energy is consumed. Reporters indicate whether their energy end-use projects affect emissions in the industrial, commercial, residential, or agricultural sector. For 2001, 193 projects were reported to have reduced emissions in the industrial sector, 128 in the residential sector, 112 in the commercial sector, and 19 in the agricultural sector. Fewer end-use projects were reported for each sector for 2001 than were reported for 2000, and the total number of end-use projects reported was 14 percent below the total for 2000 (Figure 11). It should be noted that many projects—particularly utility DSM programs—affect more than one end-use sector and are included in each applicable sector for the purposes of counting types of projects reported.

Figure 9. Energy End-Use Projects Reported on Form EIA-1605 by Size and Type of Emission Reduction, Data Year 2001



Source: Energy Information Administration, Form EIA-1605.

Figure 10. Demand-Side Management Projects Reported on Form EIA-1605 by Load Shape Objective, Data Year 2001



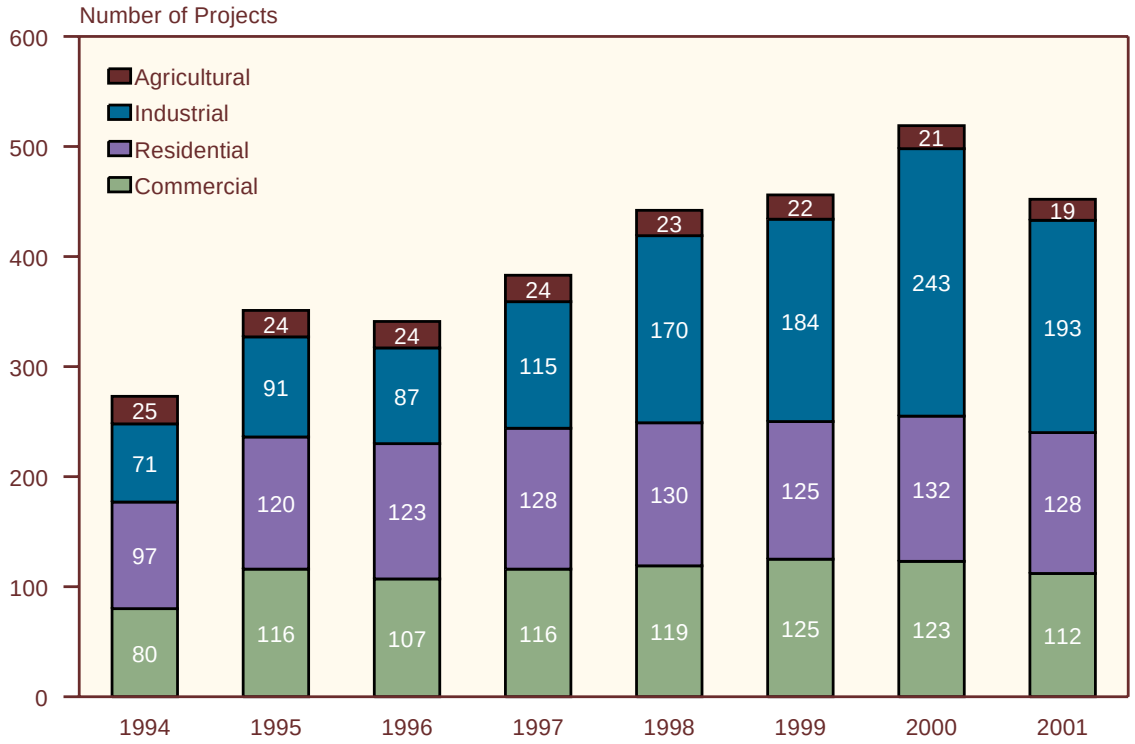
Notes: Some projects may be counted in more than one category. Figure excludes data from confidential reports.

Source: Energy Information Administration, Form EIA-1605.

Project Types

Of the 329 energy end-use projects reported, 33 percent involved two or more project types. The most frequently reported type of energy end-use project for 2001 was equipment and appliances, with 150 projects, followed by lighting and lighting controls (134 projects) and HVAC (106 projects) (Table 11). Because of the varied levels of data aggregation in reports by different entities, it is not possible to calculate average emission reductions by project type or to draw conclusions about the most effective energy end-use project types in terms of total emission reductions achieved.

Figure 11. Energy End-Use Projects Reported on Form EIA-1605 by Sector, Data Years 1994-2001



Notes: Some projects target more than one sector and may be counted in multiple categories. Figure excludes data from confidential reports.

Source: Energy Information Administration, Form EIA-1605.

Load Shape Effects: Definitions and Terminology

Energy Efficiency. Projects that improve the energy efficiency of specific end-use devices and systems. Such projects usually reduce overall energy consumption, often without regard for the timing of project-induced savings. Generally, energy savings are achieved through the substitution of technically more efficient measures (i.e., equipment, systems, or operating procedures) to produce the same level of end-use service (e.g., lighting or warmth) with less energy use.

Load Building. Projects that increase energy consumption, generally without regard to the timing of the increase. Promotion of residential electric space heating systems and promotion of new industrial electrotechnologies are examples of electricity load-building projects.

Load Shifting. Projects that move energy consumption from one time to another (usually during a single day). For example, water-heater timers typically turn off the units during the daytime (when an electric utility experiences peak demands) and allow the units to operate at night (during the utility's off-peak period).

Peak Clipping. Projects that reduce energy demand at certain critical times, typically when the utility experiences system peaks. These projects generally have only small effects on overall energy use but focus sharply on reducing energy use at critical times. Load-shifting and peak-clipping differ because the former shifts much of the energy use from one time to another, whereas the latter eliminates a load without shifting it to another time period.

Valley Filling. Projects that increase off-peak energy consumption (without necessarily reducing on-peak demands). Replacement of an oil-fired furnace with an electric heat pump is an example of valley filling. Such projects can aim to fill daily or seasonal valleys.

Equipment and Appliances

Equipment and appliance replacements with more energy efficient units (e.g., Energy Star products) are frequently reported energy end-use projects to reduce greenhouse gas emissions. For 2001, two new reporters to the Voluntary Reporting of Greenhouse Gas Emissions Program submitted reports on equipment and appliance projects. City Public Service reported two new projects that reduced direct emissions. The Wash Right Rebate program, operational since 1998, is a residential washing machine rebate program. The Mow Down Smog program, which also became operational in 1998, offers incentives for City Public Service customers to trade in gasoline-powered lawn mowers for electric. Ford Motor Company, the other new reporter, continued process upgrades and energy efficiency programs that produced emission reductions during 2001. In one project, the company upgraded 17 recuperative thermal oxidizers or replaced them with catalytic units, saving both natural gas and electricity consumption at plants throughout the United States. In 1996, the company made more than 200 equipment and appliance upgrades, producing recurring savings of electricity and natural gas and their associated greenhouse gas emissions.

In addition to the new reporters' projects, two other new equipment and appliance projects were reported for 2001. Lucent Technologies, Inc., reported a newly operational project in addition to other ongoing projects reported in previous years. The Lucent Technologies project eliminated a 15-horsepower fan in an industrial plant. Seattle City Light reported on its Neighborhood Power Weatherization / Warm Home Program for the first time for 2001. The Warm Home Program, which became operational in 1994, provides incentives for energy-conserving equipment and appliance upgrades to reduce hot water heater system usage, such as efficient-flow showerheads, kitchen and bath faucet aerators, and water heater thermostat setbacks. The program also includes building shell and lighting project activities.

Lighting and Lighting Controls

Lighting and lighting control projects, such as installing compact fluorescent bulbs and occupancy sensor lighting controls, have consistently been popular projects in the Voluntary Reporting of Greenhouse Gases Program. Six new lighting projects were reported for 2001, five by repeat reporters. A new reporter for 2001, City Public Service, submitted a residential lighting and lighting controls project that became operational in 2000. In this project, City Public Service initiated a program to replace mercury vapor streetlights with energy-efficient metal halide lights. For 2000 and 2001, the lighting project reported 39 and 1,453 metric tons of direct carbon dioxide emission reductions. Moorhead Public Service, a previous reporter but a first-time reporter on the long form in 2001, included a new project called Custom Rebate for Concordia College. The effort entailed retrofitting a bathroom in one dormitory building with occupancy sensors, which achieved a reported reduction of

Table 11. Number of Projects and Emission Reductions Reported on Form EIA-1605 for Energy End-Use Projects by Project Type, Data Year 2001

Project Type	Number of Projects Reported	Number of Projects Reporting Emission Reductions			Emission Reductions Reported (Million Metric Tons Carbon Dioxide Equivalent)	
		Direct	Indirect	Both Direct and Indirect	Direct	Indirect
Equipment/Appliances	150	79	90	19	14.9	6.4
Lighting/Lighting Controls	134	73	70	9	16.6	6.1
HVAC	106	61	56	11	16.3	5.1
Building Shell	60	39	28	7	15.4	4.6
Load Control	57	38	29	10	13.4	3.0
Motor/Motor Drive	54	35	28	9	13.9	4.3
Fuel Switching	17	12	10	5	5.5	0.9
Energy Effects of Urban Forestry	9	8	3	2	4.0	*
Industrial Power Systems	5	1	4	0	*	0.2
Other[a]	25	15	15	5	1.4	0.2
Total	**329**	**166**	**201**	**38**	**19.4**	**7.6**

[a]Includes all projects that cannot meaningfully be included in any of the specific project type categories.

*Less than 0.05 million metric tons.

Note: Project totals and emission reductions do not equal sum of components, because some projects are counted in more than one category.

Source: Energy Information Administration, Form EIA-1605.

12 metric tons of direct carbon dioxide emissions. Lucent Technologies reported two new small projects, in which a light switch was installed in a data closet and a timer was installed on outdoor lights, for total reductions of 7 metric tons carbon dioxide equivalent in indirect emissions. Allergan, Inc., reported a lighting upgrade project at its plant in Irvine, California, with reductions of 66 metric tons carbon dioxide equivalent in indirect emissions. PacifiCorp reported a project in which it began mailing about 602,000 forms for free compact fluorescent bulbs to its customers in January 2001, estimating a reduction of 62,647 metric tons of direct carbon dioxide emissions in 2001.

Heating, Ventilation, and Air Conditioning (HVAC)

HVAC projects involve the reduced use or upgrade of HVAC systems in homes, businesses, offices, or industrial plants. Although there were no new reporters in the HVAC category, three new projects were reported for 2001. Lucent Technologies reported a newly operational project in addition to other ongoing HVAC projects that it has reported in past years. Using an energy conservation approach, Pratt & Whitney, Middletown, reduced the operation of the exhaust and supply air handling units in an industrial building from 24 hours a day year-round to an operation that cycles the units on and off. Pratt & Whitney reported no changes in the temperature of the building and detected no ventilation problems after implementation of the project, which reduced greenhouse gas emissions by a reported 374 metric tons carbon dioxide equivalent in 2001. Allergan, Inc., reported a project in which a variable frequency drive was added to an existing 380-ton chiller in October 2001, achieving a reported carbon dioxide emission reductions of 26 metric tons by the end of the year.

Building Shell

Building shell projects improve the energy efficiency of buildings through upgrades to ceilings, walls, floors, windows, or doors (e.g., insulation, air sealing, or efficient materials). A large share of the projects reported in the building shell category involved DSM programs by electric power providers. There were three new building shell projects reported for 2001. The Los Angeles Department of Water and Power reported that its Reflective Window Film Rebate Program avoided 56 metric tons of direct carbon dioxide emissions. In addition, Pratt & Whitney, Middletown, conducted a roof replacement and installed high-speed doors, for a combined emission reduction of 312 metric tons carbon dioxide.

Load Controls

Load controls are energy management techniques for minimizing—either overall or at specific times of the day—the load demands on the electric power provider. Power companies themselves can use load management options and also, through DSM programs, encourage their customers to apply load controls. Independently, power consumers can employ load controls to reduce their energy consumption, shift their demand to non-peak times, reduce their consumption during peak times, and save energy costs. Load control options include energy efficiency projects, load building, load shifting, peak clipping, and valley filling (see box on page 34).

For 2001, Los Angeles Department of Water and Power reported on a newly operational Reflective Window Film Rebate Program that reduced emissions through peak clipping. In addition, FirstEnergy Corporation, which in 2001 completed a merger with GPU, Inc., reported a new Thermal Energy Storage project that reduced carbon dioxide emissions by 3,772 metric tons in 2001. This project, which became operational in 1993, reduced summer weekday peak electric loads for space and process cooling applications by shifting those loads to off-peak periods.

Motor and Motor Drive

High- or ultra-high-efficiency motors and variable-speed or variable-frequency motor drives are more energy efficient than regular motors and motor drives. In addition, controls can be used to reduce electrical consumption by adjusting motor speeds or turning off motors when appropriate. Motor and motor drive projects are generally reported in the commercial and industrial categories, and often they are a component of DSM programs.

All 54 motor and motor drive projects reported for 2001 are projects that were initiated in previous years and are either ongoing or completed but continue to provide recurring emission reductions. For example, FirstEnergy Corporation reported on an existing motor / motor drive project that became operational in 1991. The FirstEnergy project involved efficiency and electrotechnology as a component of a DSM program. Moorhead Public Service submitted an ongoing project that offered a customer rebate to a manufacturing company for two motor and adjustable-speed drive upgrades in 1996 and an additional unit replacement in 1998.

Fuel Switching

Switching from high-carbon to low-carbon fuels reduces carbon dioxide emissions generated during combustion. There were no new reporters in the fuel switching energy end-use category for 2001, but one entity reported a new project. Portland General Electric Co. reported a fuel-switching project that offered rebates to customers to purchase electric lawnmowers and turn in gas-powered mowers. The project is applicable to both the fuel switching and the equipment and appliances project types.

Energy Effects of Urban Forestry

Urban forestry is the planting and maintenance of individual trees within a city or community. Urban forestry projects can reduce both carbon dioxide emissions and energy expenditures for urban heating and cooling. In terms of energy end use, urban forestry projects can increase the efficiency of building heating and cooling. Urban forestry projects can also sequester carbon, as discussed in Chapter 4.

For 2001, the Los Angeles Department of Water and Power reported on a newly operational project, called Trees for a Green LA, which capitalized on the energy effects of urban forestry. This project is an urban tree-planting program that provides energy efficiency and environmental benefits for customers. The purpose of the project is to increase energy efficiency in residential, commercial, and newly constructed buildings; to plant trees for public buildings and public spaces; and to replace trees under power lines. The goal is to plant 100,000 trees a year for two years under this pilot program, 95 percent of which are slated for residential areas. Recipients attend workshops to learn about proper placement, benefits, and care of trees and are given a comprehensive tree guide to take home. The Los Angeles Department of Water and Power attributed a reduction of 6 metric tons carbon dioxide to Trees for a Green LA in 2001.

Industrial Power Systems

Industrial power system projects include boiler system upgrades or replacements and turbine optimization. There were no new reporters or projects in the industrial power system category for 2001. Ongoing projects include the replacement of an existing centrifugal compressor with a more efficient three-stage centrifugal air compressor by Pratt & Whitney, Middletown. In addition, Alliant Energy reported continuing reductions in greenhouse gas emissions from industrial power system projects that were implemented to comply with energy efficiency legislation enacted in Iowa.

Other

There were four new projects in the other project type category for the 2001 reporting year, one of which was from a new reporter. The reporters of new projects include Allergan, Inc., Ford Motor Company, and Pratt & Whitney, Middletown. The newly operational projects include an Allergan facility closure that reduced indirect emissions by 1,867 metric tons carbon dioxide equivalent and two Pratt & Whitney, Middletown, projects that repaired compressed air leaks in various facilities. The new reporter, Ford Motor Company, reported reducing direct carbon dioxide emissions by 61,930 metric tons and indirect emissions by 83,828 metric tons carbon dioxide equivalent in 2001 through performance contracts that Ford implemented with energy supply companies. The reported emission reductions were achieved through boiler conversions, lighting improvements, and other energy efficiency projects. Ford reported that energy savings and related cost savings are third-party verified as part of each contract.

Reducing Emissions from Transportation

The transportation sector is the largest contributing sector to the total U.S. emissions of carbon dioxide, accounting for 32 percent of emissions in 2001. These emissions result from the combustion of fossil fuels, and 98 percent result from the use of petroleum fuels. Emissions from the transportation sector increased by 19 percent between 1990 and 2001, from 1,582 million metric tons carbon dioxide to 1,876 million metric tons carbon dioxide.[12] The increase was caused by increases in both the average number of miles driven per vehicle and the total number of vehicles on the road. The average number of miles driven by motor vehicles increased by 9.6 percent between 1990 and 2000,[13] and the number of vehicles on the road increased by 14.2 percent between 1990 and 1999.[14] Although emissions were extenuated somewhat by an increase in average U.S. vehicle fleet fuel efficiency from 16.4 miles per gallon to 16.9 miles per gallon between 1990 and 2000, the trend has been reversed since 1997 when fuel efficiency peaked at 17.0 miles per gallon.[15]

A total of 53 transportation projects were reported on Form EIA-1605 for 2001 by 31 entities, all but 3 of which were electric utilities. One of the nonutilities was CLE Resources, a subsidiary of an electric utility. The 2 others were a cement producer (Arizona Portland Cement Co.) and a household. All but 1 of the 53 transportation projects reported on Form EIA-1605 have been reported

[12]Energy Information Administration, *Emissions of Greenhouse Gases in the United States 2001*, DOE/EIA-0573(2001) (Washington, DC, December 2002), Table 9, p. 34, web site www.eia.doe.gov/oiaf/1605/1605a.html.

[13]Energy Information Administration, *Annual Energy Review 2001*, DOE/EIA-0384(2001) (Washington, DC, November 2001), p. 61, web site www.eia.doe.gov/emeu/aer/.

[14]U.S. Department of Transportation, Bureau of Transportation Statistics, *National Transportation Statistics 2001*, BTS02-06 (Washington, DC, July 2002), Table 1-9, web site www.bts.gov/publications/nts/html/table_01_09.html.

[15]Energy Information Administration, *Annual Energy Review 2001*, DOE/EIA-0384(2001) (Washington, DC, November 2002), p. 62, web site www.eia.doe.gov/emeu/aer/.

in previous years.[16] The new project was a travel reduction initiative reported by Southern Company describing how two of its subsidiaries, Georgia Power and Alabama Power, encourage employees to carpool, vanpool, telecommute, and use mass transit. Thirty-six (68 percent) of the projects reported for 2001 were affiliated with the Climate Challenge program. Affiliation with the U.S. Environmental Protection Agency's ClimateWise Program, which has been absorbed into the Energy Star Program, was reported for one project.

Tables 12 and 13 show transportation project trends in the first eight reporting cycles of the Voluntary Reporting Program. The projects reported for 2001 fall into three broad categories:[17]

- Alternative fuel use (28 projects or 53 percent)
- Travel reduction (21 projects or 40 percent)
- Vehicle efficiency improvements (5 projects or 9 percent).

The primary effect of the transportation projects reported was to reduce emissions of carbon dioxide, although reductions in emissions of nitrous oxide or methane were also reported for 6 projects. For 9 of the 53 projects reported, either reductions did not occur in 2001 or they were not estimated.[18]

Direct reductions totaling 44,996 metric tons carbon dioxide equivalent were reported for 35 projects in 2001 (Table 12). This represents a significant increase from the 22,611 metric tons carbon dioxide equivalent in direct reductions reported for 2000, primarily as a result of increased activity in PG&E Corporation's natural gas vehicle project. PG&E reported reductions in direct emissions of carbon dioxide totaling 27,194 metric tons in 2001, up from 5,091 metric tons in 2000.

Indirect emission reductions in 2001 totaling 88,023 metric tons carbon dioxide equivalent were also reported for 22 projects. The sources of the reductions included "fuel cycle" emissions associated with production, refining, transportation, and distribution of fossil fuels; customer-owned natural gas vehicles refueled by natural gas distribution companies; employee vehicles affected by reporter-sponsored travel reduction programs, such as carpooling; and railroad-owned locomotives hauling coal in lightweight aluminum rail cars owned by electric utilities. Indirect reductions from transportation projects reported for 2001 declined significantly from those reported for 2000, primarily due to the absence of 2001 reports from 5 reporters who reported 7 projects for 2000, with combined reductions of 58,017 metric tons carbon dioxide equivalent.

Using Alternative Fuels

More than one-half (53 percent) of the transportation projects reported for 2001 involved alternative-fuel vehicles (AFVs). These projects accounted for 73 percent

Table 12. Number of Projects and Emission Reductions Reported on Form EIA-1605 for Transportation Projects by Project and Reduction Type, Data Years 1994-2001

Year	Number of Projects				Emission Reductions (Metric Tons Carbon Dioxide Equivalent)	
	Vehicle Efficiency	Travel Reduction	Alternative Fuels	Total	Direct	Indirect
1994	3	6	18	**26**	4,203	6,346
1995	6	14	21	**40**	22,660	54,061
1996	7	15	26	**47**	28,813	54,043
1997	9	20	27	**55**	32,283	95,782
1998	9	23	28	**58**	25,085	89,174
1999	10	25	30	**62**	43,499	282,257
2000	9	25	32	**64**	22,611	134,519
2001	5	21	28	**53**	44,996	88,023

Notes: Project totals do not equal sum of components, because some projects are counted in more than one category. Table excludes data from confidential reports.

Source: Energy Information Administration, Form EIA-1605.

[16]In some cases, projects reported last year (data through 2000) have been included in the reports submitted this year (data through 2001) by companies that have resulted from mergers of the companies that reported last year. Projects reported separately by ComEd and PECO for 2000 were reported by Exelon Corporation for 2001. Projects reported by GPU for 2000 were reported by FirstEnergy for 2001.

[17]The sum of projects in each category exceeds the total number of projects because some projects are counted in more than one category.

[18]In some cases, reductions for the project may have been reported for years before 2001. In other cases, the reductions were not estimated due to the lack of data or other difficulties in quantifying the effects of the project. Entities may elect to report projects without reporting reductions to make a public record of the fact that they have conducted an activity in fulfillment of a commitment made under a voluntary program such as Climate Challenge.

of reported direct reductions but only 2 percent of reported indirect reductions. In general, the reported reductions for AFV projects were small, with reductions in excess of 1,000 metric tons carbon dioxide equivalent being reported for only four projects. All the AFV projects reported for 2001 were reported in previous years.

AFV projects involved a variety of fuels, including natural gas, electricity, propane, and E-85 (a blend of 85 percent ethanol and 15 percent gasoline). Electricity was included in 13 project reports. Southern California Edison's electric vehicles reportedly logged over 1.9 million miles in 2001, more than 10 times the 174,000 miles reported in 1996. The Los Angeles Department of Water and Power (LADWP) reported operating 204 electric vehicles in 2001, up from 117 in 2000 and 18 in 1996. Southern Company reported operating an electric vehicle fleet of 416 vehicles in 2001, including cars, trucks, neighborhood electric vehicles, and buses.

Fourteen projects involved the operation of compressed natural gas (CNG) or liquefied natural gas (LNG) vehicles. Three utilities reported operating fleets of CNG, LNG, or dual-fuel CNG / gasoline vehicles of more than 100 vehicles in 2001: We Energies (676 vehicles), PG&E Corporation (648 vehicles), and NiSource (982 vehicles).

Two AFV projects reported for 2001 involved fuels other than natural gas and electricity.[19] Exelon Corporation reported using E-85 in 241 vehicles and propane in another 110 vehicles. Cinergy Corp. also reported the use of AFVs fueled by propane.

Reducing Vehicle Travel

Travel reduction, which includes such activities as carpooling and vanpooling, mass transit, telecommuting, and service efficiency improvements, was reported for 21 projects for 2001—accounting for 29 percent of the direct reductions and 39 percent of the indirect reductions reported for transportation projects in 2001. One projects was newly reported by Southern Company, which has developed programs to encourage carpooling, vanpooling, mass transit use, and telecommuting. In the Atlanta area, employees of Southern Company and its subsidiary, Georgia Power, can receive free monthly passes to ride the area mass transit system (MARTA), and carpoolers can receive free downtown parking. In Birmingham and Mobile, employees are encouraged to carpool or telecommute, especially on ozone alert days in the summer. These programs resulted in reported emission reductions of 6,040 metric tons carbon dioxide in 2001.

Of the 21 projects reported in the travel reduction category, 12 involved carpooling or vanpooling, 9 increased mass transit ridership, 3 reduced employee vehicle use through telecommuting, 2 increased service efficiency for freight or service vehicles, and 8 involved other actions, such as work week compression, videoconferencing, and use of bicycles for commuting and utility meter reading.[20]

The largest travel reduction project was reported by Public Service Enterprise Group for its employee carpooling, vanpooling, and mass transit programs, which reduced indirect emissions by a reported 8,048 metric tons carbon dioxide equivalent. Reductions of more than 5,000 metric tons carbon dioxide equivalent were also reported for the following travel reduction projects:

- LADWP reported on its employee carpooling and vanpooling program (7,086 metric tons of indirect reductions of carbon dioxide emissions).

Table 13. Emission Reductions Reported on Form EIA-1605 for Transportation Projects by Project and Reduction Type, Data Years 1994-2001
(Metric Tons Carbon Dioxide Equivalent)

	Vehicle Efficiency		Travel Reduction		Alternative Fuels	
Year	Direct	Indirect	Direct	Indirect	Direct	Indirect
1994	1,244	5,651	1,170	—	1,956	695
1995	18,148	36,137	2,179	16,461	2,463	1,495
1996	18,647	38,602	5,427	13,903	4,847	1,546
1997	20,989	48,213	8,753	45,227	2,582	2,352
1998	18,436	70,527	3,110	15,923	3,632	2,746
1999	14,671	174,553	6,077	106,841	22,866	2,148
2000	53	66,324	8,549	67,404	14,021	2,306
2001	-1,109	51,905	13,059	34,052	33,053	2,068

Notes: Table excludes data from confidential reports.
Source: Energy Information Administration, Form EIA-1605.

[19]Two other reporters resubmitted information on projects that involved consumption of propane and M-85 in previous years; however, the projects were inactive in 2001.

[20]The total number of travel reduction projects is less than the sum of the projects in each subcategory, because some projects include activities in more than one subcategory.

- TXU reported efforts to reduce fleet vehicle use (7,358 metric tons carbon dioxide equivalent of direct emission reductions and 1,871 metric tons carbon dioxide equivalent of indirect reductions).
- CLE Resources reported its investment, through the Edison Electric Institute's EnviroTech investment fund, in McHugh Software, a company that developed software to improve routing for service vehicles (6,163 metric tons of indirect carbon dioxide emission reductions).

Improving Vehicle Efficiency

Emission reductions were reported for only two of the five vehicle efficiency projects reported for 20001. The two projects, both of which involved the use of light-weight aluminum railroad cars to transport coal, were among the three largest reductions reported for transportation projects in 2001. Both projects resulted in indirect emission reductions, in that the locomotives using less fuel were owned by the railroads. Ameren Corporation reported reducing emissions by 29,630 metric tons carbon dioxide and Kansas City Power & Light Company reported reducing emissions by 22,275 metric tons carbon dioxide.

For another project—Arizona Portland Cement Company's use of more efficient haul trucks—a direct emission increase of 1,109 metric tons carbon dioxide was reported for 2001. Because of scheduling and mechanical difficulties, Arizona Portland Cement Company increased the use of its older, less efficient 85-ton capacity trucks in place of its newer, more efficient 100-ton trucks to haul quarried limestone.

CLE Resources, a subsidiary of Cleco Corporation, continued to report its investment (through the EnviroTech fund established by the Edison Electric Institute) in a company that developed and commercialized a device for monitoring and adjusting tire pressure on trucks to achieve optimal fuel efficiency. CLE Resources did not report emission reductions for this project, due to the unavailability of reliable data on the number of devices sold.

4. Carbon Sequestration

Background

Carbon sequestration plays an important role in the global carbon cycle. Green plants remove (sequester) carbon from the atmosphere through photosynthesis, extracting carbon dioxide from the air, separating the carbon atom from the oxygen atoms, returning oxygen to the atmosphere, and using the carbon to make biomass in the form of roots, stems, and foliage.

Every year in the United States and throughout the world a very large amount of carbon dioxide—on the order of 120 billion metric tons of carbon—is sequestered in biomass.[21] At the same time, carbon is released to the atmosphere from vegetative respiration, combustion of wood as fuel, degradation of manufactured wood products, consumption of biomass for food by animals, and the natural decay of expired vegetation. The net numerical difference, or flux, between carbon sequestration and release can be viewed as a measure of the relative contribution of biomass to the carbon cycle. World flux associated with Earth's living matter is difficult to measure, but biomass is thought to provide a net "sink" equivalent to about 5.1 billion metric tons carbon dioxide per year.[22]

Forests can play an important role in offsetting human-produced carbon emissions. On average, trees are approximately 25 percent carbon by weight (live trees are approximately 50 percent water by weight, and oven-dried wood is approximately 50 percent carbon by weight).[23] The amount of carbon a plant can sequester depends on a number of variables, including species and age, but can be quite large. For example, one large sugar maple tree is capable of removing more than 450 pounds of carbon dioxide from the atmosphere in a year. At that rate, preserving 31 trees per operating automobile in the United States would offset all U.S. automobile-related carbon dioxide emissions.[24]

Carbon sequestration on a national scale is substantial. The U.S. Environmental Protection Agency, relying heavily on the work of U.S. Forest Service Researchers Richard Birdsey and Linda Heath, estimates annual U.S. carbon sequestration (generally defined according to the guidelines of the Intergovernmental Panel on Climate Change) at 246 million metric tons carbon equivalent,[25] which offsets approximately 13 percent of annual U.S. anthropogenic emissions of greenhouse gases.[26]

Projects Reported

Fifty-one entities reported projects on Form EIA-1605 that involved forestry or natural resources that sequestered carbon or reduced emissions in 2001 (Table 14). The reporters included 45 electric utilities, 3 operating subsidiaries of an independent power producer, a real estate company, a State agency, and a city cogeneration plant engaging in a forestry habitat restoration project. A total of 369 carbon sequestration projects were reported, a decrease of 21 percent from the 2000 data year. Forestry projects were the second most commonly reported project type after electricity generation, transmission, and distribution (see Chapter 2), and they accounted for 25 percent of all the projects reported on the long form for 2001 (see Table 2 in Chapter 1). The reported forestry projects were dispersed over a wide geographic area, including 31 States and 8 foreign countries. A total of 303 domestic and 66 international forestry projects were reported. Thirty-two of the foreign projects represent individual equity shares in a single forest preservation project in Belize, the Rio Bravo Carbon Sequestration Pilot Project.

[21] Intergovernmental Panel on Climate Change, *Climate Change 2001: The Scientific Basis* (Cambridge, UK: Cambridge University Press, 2001), p. 188.

[22] Intergovernmental Panel on Climate Change, *Climate Change 2001: The Scientific Basis* (Cambridge, UK: Cambridge University Press, 2001), p. 39.

[23] R.A. Birdsey, *Carbon Storage and Accumulation in United States Forest Ecosystems* (Washington, DC: USDA Forest Service, 1992), p. 12.

[24] Average mileage and fuel consumption for passenger cars from Energy Information Administration, *Annual Energy Review 2001*, DOE/EIA-0384(2001) (Washington, DC, November 2002), p. 61, web site www.eia.doe.gov/emeu/aer/. Carbon dioxide emissions per mile driven and gallon of motor fuel from U.S. Department of Energy, *Sector-Specific Issues and Reporting Methodologies Supporting the General Guidelines for the Voluntary Reporting of Greenhouse Gases Under Section 1605(b) of the Energy Policy Act of 1992*, DOE/PO-0028 (Washington, DC, October 1994), Vol. 2, p. 4.19.

[25] U.S. Environmental Protection Agency, *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2000*, EPA-236-R-02-003 (Washington, DC, April 2002), p. 6-2, web site www.epa.gov.

[26] U.S. athropogenic greenhouse gases emissions were 1,883 million metric tons carbon equivalent in 2001. Energy Information Administration, *Emissions of Greenhouse Gases in the United States 2001*, DOE/EIA-0573(2001) (Washington, DC, December 2002), p. ix, web site www.eia.doe.gov/oiaf/1605/1605a.html.

The total sequestration reported on Form EIA-1605 for 2001 declined by 12 percent from the previous year, to 7,956,823 metric tons carbon dioxide (Table 14). The reduction was primarily a result of the absence of a 2001 report for 164 carbon sequestration projects that were reported for 2000 under American Forests' Global ReLeaf Forests program.

Of the sequestration projects reported for 2001, most (285 or 77 percent) involved some kind of tree planting, which included afforestation, reforestation, urban forestry, and woody biomass production or agroforestry (Table 15).[27] These projects accounted for 13 percent of the sequestration (and related direct and unspecified emission reductions) reported for 2001. Although only 37 forest preservation projects were reported, they accounted for 86 percent of the sequestration reported for 2001. Ninety-one percent of the total sequestration for 2001 was reported on behalf of foreign projects, which include some very large forest preservation and agroforestry initiatives.

Nine percent of the reported projects were urban forestry projects, involving the planting of trees in urban and suburban areas. Urban forestry projects are typically much smaller than forestry projects undertaken in rural or wilderness areas. The average carbon dioxide sequestration reported per urban forestry project for 2001 was just 338 metric tons. In contrast, projects in rural or wilderness areas are sometimes large: 6 such projects sequestered more than 100,000 metric tons carbon dioxide each in 2001 (Figure 12). For the 369 projects for which data were reported, average sequestration for 2001 was 21,563 metric tons carbon dioxide per project.

Almost all (353 or 96 percent) of the reported sequestration projects were undertaken in part to fulfill commitments made under the U.S. Department of

Table 14. Number of Projects, Carbon Sequestered, and Net Reductions Reported on Form EIA-1605 for Sequestration Projects, Data Years 1994-2001

Data Year	Number of Reporters	Number of Projects	Sequestration (Metric Tons Carbon Dioxide Equivalent)	Net Emission Reductions (Metric Tons Carbon Dioxide Equivalent)	
				Direct	Indirect
1994	23	58	746,545	189	23,127
1995	44	175	1,190,754	378	48,730
1996	51	175	8,676,591	1,291	32,215
1997	56	279	9,849,807	6,160	—
1998	57	321	12,490,927	716	—
1999	53	401	9,623,599	3,406	—
2000	53	468	9,011,117	1,041	—
2001	51	369	7,956,823	1,114	—

Source: Energy Information Administration, Form EIA-1605.

Table 15. Number of Sequestration Projects Reported on Form EIA-1605 by Project Type, Data Years 1994-2001

Data Year	1994	1995	1996	1997	1998	1999	2000(R)	2001
Afforestation	26	38	38	91	101	158	181	245
Reforestation	15	81	79	91	109	136	167	10
Urban Forestry	8	17	21	23	28	28	31	33
Modified Forest Management	12	20	10	33	41	42	44	41
Woody Biomass Production and Other Agroforestry	8	14	2	3	3	3	3	3
Forest Preservation	2	22	29	38	43	38	42	37
Conservation Tillage	1	1	1	2	2	2	2	2
Other Projects	3	6	6	10	5	5	5	5
Total	**58**	**175**	**175**	**279**	**321**	**401**	**468**	**369**

(R) = revised.
Note: Project totals do not equal sum of components, because some projects are counted in more than one category.
Source: Energy Information Administration, Form EIA-1605.

[27] Afforestation is the planting of trees in unforested areas. Reforestation is the planting of trees in forest areas that have recently been harvested. Urban forestry is the planting of trees individually or in small groups in urban or suburban settings. Agroforestry is the cultivation of trees in plantations for fuel or fiber.

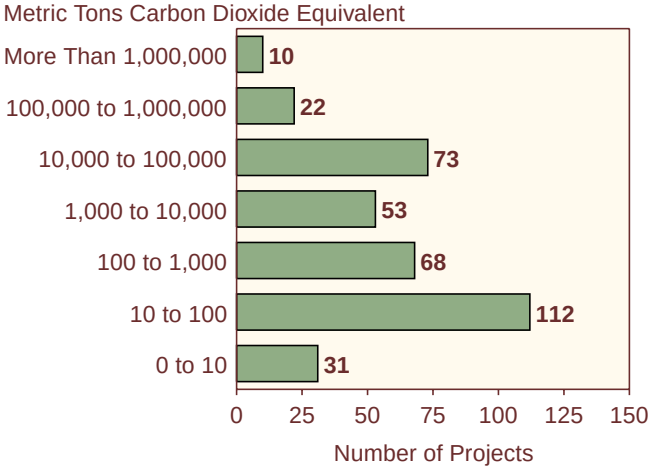
Energy's Climate Challenge program. Twenty-seven of the investors in the UtiliTree Carbon Company each submitted reports on the nine projects that were operational in 2001. All the investors reporting were also participants in Climate Challenge. In addition, 34 (9 percent) of the sequestration projects reported on Form EIA-1605 for 2001 were undertaken as part of the U.S. Initiative on Joint Implementation (USIJI). Established under the Climate Change Action Plan (CCAP),[28] the USIJI is a pilot program that seeks to encourage foreign-based emission reduction and carbon sequestration projects conducted by U.S. and non-U.S. partners. Two USIJI-approved forestry projects were reported to the Voluntary Reporting Program: the Rio Bravo Carbon Sequestration Pilot Project (Belize) and the Noel Kempf Mercado Climate Change Action Project (Bolivia).

Afforestation and Reforestation

Of the sequestration projects reported for 2001, 251 (68 percent) involved either afforestation or reforestation. The carbon sequestration and emission reductions reported for these projects totaled 637,889 metric tons carbon dioxide, representing 8 percent of the total sequestration reported for 2001. All but one of the afforestation and reforestation projects reported for 2001 were domestic.

American Electric Power, Inc. (AEP), a large investor-owned utility, accounted for the largest number of sequestration projects (14 percent of the 251 afforestation and reforestation projects) reported for 2001. AEP reported 34 afforestation projects on land owned by its operating companies, which sequestered a reported 147,271 metric tons carbon dioxide in 2001. Three of the projects were initiated in 2001. American Forests, which reported more than one-third of all the sequestration projects reported for 2000, did not report for 2001.

Figure 12. Carbon Sequestration Projects Reported on Form EIA-1605 by Amount of Carbon Sequestered, Data Year 2001



Source: Energy Information Administration, Form EIA-1605.

UtiliTree Carbon Company members reported three new afforestation projects for 2001: the Bayou Cocodrie Bottomland Hardwood Forest Restoration project, the St. Catherine-NFWF project, and the St. Catherine-ESI project. Twenty-seven separate UtiliTree members reported on each of the three projects, as well as the ongoing effects of six UtiliTree projects previously reported.

The Bayou Cocodrie Bottomland Hardwood Forest Restoration project was undertaken as a cooperative agreement between the U.S. Fish and Wildlife Service, the National Wildlife Foundation, and the UtiliTree Carbon Company. The project involves the restoration of 400 acres of bottomland hardwood on marginal agricultural farmland recently acquired by the Fish and Wildlife Service, which will be added to the Bayou Cocodrie National Wildlife Refuge. The project resulted in the reported sequestration of approximately 401 metric tons carbon dioxide among all 27 reporters for 2001.

The St. Catherine NWF and ESI projects consist of the creation of carbon sinks by converting marginal agricultural lands (600 acres in the case of St. Catherine NWF and 500 acres in the case of St. Catherine ESI) to forest cover by the planting of trees. According to the UtiliTree reporters, Federal funds would not be dedicated on the scale necessary to reforest the properties, and the land would likely be used for farming for the foreseeable future without these projects. Not only do the projects provide the benefit of sequestration of incremental carbon through the accumulation of biomass above and below ground, they will also eliminate carbon dioxide emissions from agricultural cultivation equipment. Together, these projects resulted in the reported sequestration of approximately 1,277 metric tons carbon dioxide among all 27 reporters for 2001.

Urban Forestry

A total of 33 urban forestry projects were reported for 2001 by 25 reporters, all of which were electric utilities. For the 33 projects, a total of 11,154 metric tons carbon dioxide was sequestered in 2001—an amount that would offset less than 0.1 percent of the emissions from a 1,000-megawatt coal-fired power plant.[29]

[28] President William J. Clinton and Vice President Albert Gore, Jr., *The Climate Change Action Plan* (Washington, DC, October 1993), Appendix II, web site www.gcrio.org/USCCAP/toc.html.

[29] Assuming a power plant with a heat rate of 12,000 Btu per kilowatthour operating at 85 percent availability using subbituminous coal emitting 212.7 pounds of carbon dioxide per million Btu.

Urban forestry projects are unique, in that under some circumstances they can reduce energy consumption as well as sequester carbon. Shade trees planted near buildings reduce summer air conditioning requirements; in addition, trees can act as windbreaks, reducing heating needs in the winter. Although the emission reductions associated with energy effects of urban forestry can be several times the sequestration benefits on a carbon dioxide equivalent basis, they are difficult to estimate. As a result, none of the reporting entities submitted information on energy-related emission reductions for urban forestry projects.

Forest Preservation

Forest preservation projects sequester carbon by avoiding the harvesting of timber or clearing of land and thus preventing the release of stored carbon. A total of 37 forest preservation projects were reported for 2001 by 29 reporters. The two largest forest preservation projects were reported by AES Hawaii and AES Shady Point, subsidiaries of the AES Corporation. Together, these two projects sequestered a reported 5.68 million metric tons carbon dioxide in 2001, representing 83 percent of the total sequestration reported for forest preservation projects.

Two utilities (AEP and PacifiCorp) reported on the Noel Kempf Mercado Climate Action Project in Bolivia, which was accepted by the USIJI in November 1996. The project, which involves the preservation of 634,286 hectares of land on the southern and western boundary of the Noel Kempf Mercado National Park by incorporating it into the park, includes the following components: (1) carbon dioxide emission reductions through the cessation of logging activities and the protection of forest land from conversion to agricultural use; (2) protection, regeneration, and preservation; and (3) leakage prevention.[30] The sequestration reported by AEP and PacifiCorp totaled 803,484 metric tons carbon dioxide for 2001.

The Rio Bravo Carbon Sequestration Pilot Project, a forest preservation project in Belize, was included in the reports submitted by 27 utilities, each of which reported its prorated share of the total sequestration for the project. Begun in 1995, the project is being undertaken through a partnership between Cinergy Corporation, DTE/Detroit Edison, PacifiCorp, Wisconsin Electric Power Co., the UtiliTree Carbon Company, the Nature Conservancy, and a Belizean nongovernmental organization (Programme for Belize). The project includes the purchase of a 14,400-acre parcel of endangered forest threatened with conversion to agriculture.

The entire Rio Bravo Carbon Sequestration Pilot Project sequestered an estimated 147,759 metric tons carbon dioxide in 2001, of which 142,946 metric tons (97 percent) was reported to the Voluntary Reporting of Greenhouse Gases Program.[31] This represents an 77-percent decline from the sequestration reported for 2000 (620,991 metric tons carbon dioxide), which occurred because the preservation of the forest is nearing completion. The reported carbon sequestration for this project was estimated by defining a reference case that assumes a profile of carbon releases that would have occurred if the project had not been undertaken and the forest had been converted to agriculture. The estimated carbon sequestration equals the projected avoided carbon releases. Project completion will occur when the conversion to agriculture would have been completed under the reference case scenario.

Only one domestic forest preservation project was reported for 2001, by Alliant Energy, which reported sequestering 1,597 metric tons carbon dioxide by maintaining forested buffer lands around its power plants.

Modified Forest Management

Of the 41 modified forest management projects reported for 2001, 28 were associated with two related reduced-impact logging initiatives in Malaysia. The first initiative was a pilot project reported by PG&E Corporation.[32] Started in 1992, this project implemented new logging techniques with the goal of reducing logging damage by 50 percent. The new techniques include pre-cutting of vines, directional felling, and planned extraction of timber on impact-reducing skid trails. Twenty-seven utilities reported their shares in the second initiative—a full-scale project sponsored by the UtiliTree Carbon Company that introduced reduced-impact logging practices to 2,422 acres of forest beginning in 1997. The second initiative increased sequestration by a reported 14,767 metric tons carbon dioxide equivalent in 2001.

[30]Leakage refers to the migration of logging and land-clearing activities that would have occurred in the preserve to areas outside the preserve, which would offset the sequestration achievements of the project.

[31]Twelve UtiliTree participants did not submit reports to the Voluntary Reporting Program for data year 2001, including one Canadian utility that is ineligible to report.

[32]This project was originally sponsored by New England Power Company and reported by its parent company, New England Electric System (NEES) Company. In August 1998, USGen New England, Inc. (USGenNE) completed the acquisition of New England Electric System (NEES) Company's hydroelectric and fossil power generation business previously operated by New England Power. As part of the acquisition, the rights to the emission reductions and carbon sequestration achieved by this and other projects were transferred to USGenNE. For 2000, the activities previously reported by USGenNE were incorporated into the report submitted by its parent, PG&E Corporation.

DTE Energy/Detroit Edison conducted selective harvesting operations in previously unmanaged wood lots and reported increasing sequestration by 1,398 metric tons in 2001. Alliant Energy reported enhanced forest management activities as a component of its afforestation project. AEP reported 11 projects that involved the utility's annual additions to its modified forest management efforts conducted in upland central hardwood stands. The stands are selectively harvested, removing over mature, mature, cull, and diseased trees, and other steps are undertaken as necessary to improve growing space relationships and maximize the growth rates of the stands. The combined additional sequestration reported by AEP for these projects in 2001 was 15,735 metric tons carbon dioxide.

Forest Plantations

Forest plantations include woody biomass production and agroforestry. Woody biomass production is the cultivation of trees in intensively managed plantations for the purpose of producing fuel or fiber. Agroforestry involves mixing trees with annual crops to provide wind shelter, stabilize soil, and produce fuel wood and fruit crops.

One of the three woody biomass production projects reported for 2001 was a project involving the establishment of a short-rotation cottonwood plantation on a river bottom site in Alabama, reported by J.M. Gilmer and Company. The cottonwoods will be harvested on a 12-year rotation and used as biofuel (displacing fossil fuel) or for pulpwood. After cutting, the cottonwood stand will be regrown, and a second 12-year crop rotation will begin. J.M. Gilmer and Company reported that this plantation sequestered 100 metric tons carbon dioxide in 2001.

AES Thames reported an agroforestry project in Guatemala that involves establishing a plantation of fruit, pulp, and fuel wood trees. Using a revised estimation method, AES Thames reported that its project sequestered 410,000 metric tons carbon dioxide in 2001.

The third forest plantation project reported for 2001 was Minnesota Power's Short Rotation Woody Crop Establishment project, in which the utility contracts with landowners enrolled in its Conservation Reserve Program to plant hybrid poplars. Minnesota Power reported the sequestration of 15,593 metric tons carbon dioxide through this effort in 2001.

Conservation Tillage and Other Sequestration Projects

Not all the carbon sequestration projects reported for 2001 involved conventional forestry. Other projects reported involved conservation tillage, reuse of utility poles, and restoration of terrestrial, wetland, and marine habitats. Seven such projects were reported for 2001, including one new project reported by the Indiana Association of Soil and Water Conservation Districts that involves the collection of county-level data on historical agricultural and drainage practices by the 92 Soil and Water Conservation Districts in the State. Although sequestration data for 2001 was not available, the association indicated that the sequestration data reported for previous years represent long-term changes in agricultural practices in the State of Indiana.

Exelon (formerly Commonwealth Edison and PECO) reported on its Illinois Prairie Grass Plantings project, in which native prairie grasses are planted on various properties in the utility's State system. In contrast to conventional turf grass, the deep root systems of native Illinois prairie grasses afford environmental benefits that include reducing soil erosion and downstream flooding and eliminating the need for irrigation, fertilizers, pesticides, and herbicides. In addition, the deeper root systems sequester more carbon dioxide. The project claimed responsibility for the sequestration of 658 metric tons carbon dioxide in 2001. In another project, Exelon reused wood utility poles that are structurally sound in order to avoid the harvesting of trees to manufacture new utility poles. The utility pole reuse project was reported to have sequestered 753 metric tons carbon dioxide in 2001.

Alliant Energy reported on a conservation tillage project that involved the conversion of 696 acres of former corn and soybean row cropland to a variety of other uses, including tall grass prairie, wetlands, conservation tillage, and oak savanna. This project reportedly sequestered 4,390 metric tons carbon dioxide in 2001. Alliant Energy also reported on a habitat restoration project for 2001.

Other carbon sequestration projects include the reclamation of 6 acres of wetlands by Conectiv Atlantic Generation and reclamation of wetlands in Texas and Louisiana by Entergy Services, Inc. The two projects sequestered a reported total of 54,893 metric tons carbon dioxide in 2001.

5. Reducing Methane Emissions

Introduction

U.S. anthropogenic (human-caused) methane emissions totaled 28.0 million metric tons in 2001, 3.7 million metric tons less than in 1990. Estimated emissions from landfills—the largest single anthropogenic source of methane in the United States—dropped from 11.2 million metric tons in 1990 to 8.0 million metric tons in 2001[33] as a result of a rapid increase in methane recovery at landfills in response to the now-expired Section 29 tax credit for alternative fuels and the implementation of EPA's New Source Performance Standards and Emission Guidelines.[34] Overall, methane recovery at landfills grew from about 1.0 million metric tons in 1990 to 4.9 million metric tons in 2001.[35] Although not directly correlated, the increase in activity aimed at capturing methane from landfills is reflected in reports submitted to the Voluntary Reporting Program. For the 2001 data year, reduction activities were reported on Form EIA-1605 for at least 201 separate landfills, up from 185 in 2000.[36]

Another significant component of the overall decline in U.S. methane emissions has been a drop in emissions from coal mining. Methane emissions from coal mines declined from 4.2 million metric tons in 1990 to 2.8 million metric tons in 2001.[37] To some extent, the decline is attributable to an increase in methane recovery at coal mines, from 0.3 million metric tons in 1990 to about 0.7 million metric tons in 2001. The Voluntary Reporting Program received reports on 16 emission reduction projects at coal mines for 2001, up from 14 for 2000. The 16 projects reported total direct methane emission reductions of 538,285 metric tons (12.4 million metric tons carbon dioxide equivalent) in 2001, up from 505,941 metric tons methane (11.6 million metric tons carbon dioxide equivalent) in 2000.

Although U.S. methane emissions from the production, transmission, and distribution of natural gas and from agricultural activities both increased between 1990 and 2001 (9.1 percent and 11.3 percent, respectively), some entities reported reductions in emissions from these sources. Reduced emissions from the natural gas system were reported for 19 projects, and reduced emissions from agricultural activities were reported for 3 projects.

Overview of Projects Reported

For the 2001 data year, 74 organizations reported a total of 246 projects to reduce methane emissions, a 36-percent decrease from the 2000 data year[38] and a sevenfold increase from the first (1994) reporting cycle (Table 16). Twenty-one of the projects were reported for the first time in the 2001 reporting cycle, eiher because they began achieving reductions in 2001 or because they were reported by one of seven new reporters. Some projects reported for previous years were not reported for 2001.

Direct emission reductions from all methane projects reported for 2001 totaled 2,436,799 metric tons methane, down from 2,693,295 metric tons reported for 2000 (Table 17). Of the total for 2001, 41.3 percent was attributable to 208 waste treatment projects that reported an average of 4,843 metric tons direct methane emission reductions per project. Projects to reduce methane emissions from coal mines and natural gas systems generally yielded much larger direct reductions per project (Figure 13), averaging 18,797 metric tons methane. Total direct emission reductions of 538,285 metric tons methane were reported for coal mining projects in 2001, accounting for 22 percent of the direct methane emission reductions reported for 2001. The 19 natural gas system projects reported for 2001 reduced direct emissions by a total of 119,609 metric tons methane, or about 5 percent of all reported direct methane emission reductions.

Indirect methane emission reductions from waste treatment and disposal projects totaled 1,003,287 metric tons, more than 99 percent of all indirect methane emission

[33]Energy Information Administration, *Emissions of Greenhouse Gases in the United States 2001*, DOE/EIA-0573(2001) (Washington, DC, December 2002), web site www.eia.doe.gov/oiaf/1605/1605a.html.

[34]The EPA's Landfill Methane Outreach Program (LMOP) has also contributed to the increase in methane recovery from landfills, as reflected by the large percentage of landfill gas-to-energy project developers who reported participation in LMOP as part of their submissions to the Voluntary Reporting of Greenhouse Gases Program (see Table 20 in this chapter).

[35]Energy Information Administration, *Emissions of Greenhouse Gases in the United States 2001*, DOE/EIA-0573(2001) (Washington, DC, December 2002), web site www.eia.doe.gov/oiaf/1605/1605a.html.

[36]The counts of landfills represent minimum levels, because not all reporters explicitly identified the landfills on which they were reporting. The counts exclude reports received after the close of the reporting cycles, in order to maintain comparability.

[37]Energy Information Administration, *Emissions of Greenhouse Gases in the United States 2000*, DOE/EIA-0573(2000) (Washington, DC, November 2001), web site www.eia.doe.gov/oiaf/1605/1605a.html.

[38]Excluding late reporters from the 2000 total, the decrease was much smaller (7 percent).

reductions reported on Form EIA-1605. This total included two very large projects reported by DTE Energy and the Integrated Waste Services Association (IWSA). DTE energy reported 192,064 metric tons of indirect reductions from multiple landfill gas-to-energy systems reported as one large project, and IWSA reported indirect reductions of 265,720 metric tons from the waste-to-energy facilities of its members. Overall, reported indirect reductions continued to grow in 2001, due primarily to increases in reported reductions attributed to recovery of biogas at landfills. After dropping between 1996 and 1997 due to an improvement in the estimation methods used by IWSA, indirect reductions have continued to grow as a result of increased reporting of landfill gas capture and use projects.

Methane reduction projects are more prone to double reporting than are most other greenhouse gas reduction projects (with the exception of demand-side management programs), because electricity generated from methane recovery at a landfill, coal mine, or animal waste management facility is often sold to a second party, or recovered gas is piped to a second party for use in a boiler. In such cases, the party that captures the gas may report a direct reduction and the gas or electricity purchaser an indirect reduction. Where double reporting does occur, however, double counting is avoided because electricity producers report methane reductions as indirect unless they have an ownership stake in the landfill or its gas resource, whereas landfill gas developers report methane reductions as direct. Although there may be multiple reports of the same reduction from a single project, the reduction is unlikely to be counted more than once, because the reductions would be accounted for separately as part of either direct or indirect totals. As an example, Pacific Recovery Corporation and Generating Resource Recovery Partners, L.P., reported projects on the same landfill. Pacific Recovery is responsible for recovering methane released from the Otay landfill in California. Generating Resource Recovery Partners buys the recovered methane and uses it to produce electricity. Pacific Recovery reported direct methane emission reductions of 6,582 metric tons for 2001, and Generating Resource Recovery Partners reported indirect reductions of 6,582 metric tons.

Additional instances of double reporting may occur if a project is reported by two or more entities with ownership interests. Again, however, because reporters are instructed to report only the portion of overall reductions equal to their ownership share, double counting should not occur. Finally, in instances where both biogas flaring and biogas recovery for energy occur at the same landfill, the projects may be reported more than once; however, the total reductions reported should not exceed the reductions actually achieved, because the landfill gas developer or energy purchaser will not count flared gas in biogas recovery totals.

There were 30 landfills for which more than one entity reported emission reductions for 2001, or 15 percent of

Table 16. Projects Reported on Form EIA-1605 with Methane Reductions as the Principal Outcome by Project Type, Data Years 1994-2001

Project Type	1994	1995	1996	1997	1998	1999	2000(R)	2001
Waste Management and Disposal	**17**	**23**	**44**	**53**	**90**	**153**	**350**	**208**
Landfill Gas Recovery	14	19	40	48	80	139	337	198
Wastewater Treatment	2	2	2	3	5	6	8	4
Other	1	2	2	2	5	8	5	6
Agriculture	**3**	**3**	**3**	**3**	**4**	**4**	**5**	**3**
Energy Production and Consumption	**8**	**11**	**13**	**15**	**28**	**28**	**28**	**35**
Coal Mining	2	3	4	5	17	15	14	16
Natural Gas Production, Transmission, and Distribution	6	8	9	10	11	13	14	19
Total	**28**	**37**	**60**	**71**	**122**	**185**	**383**	**246**

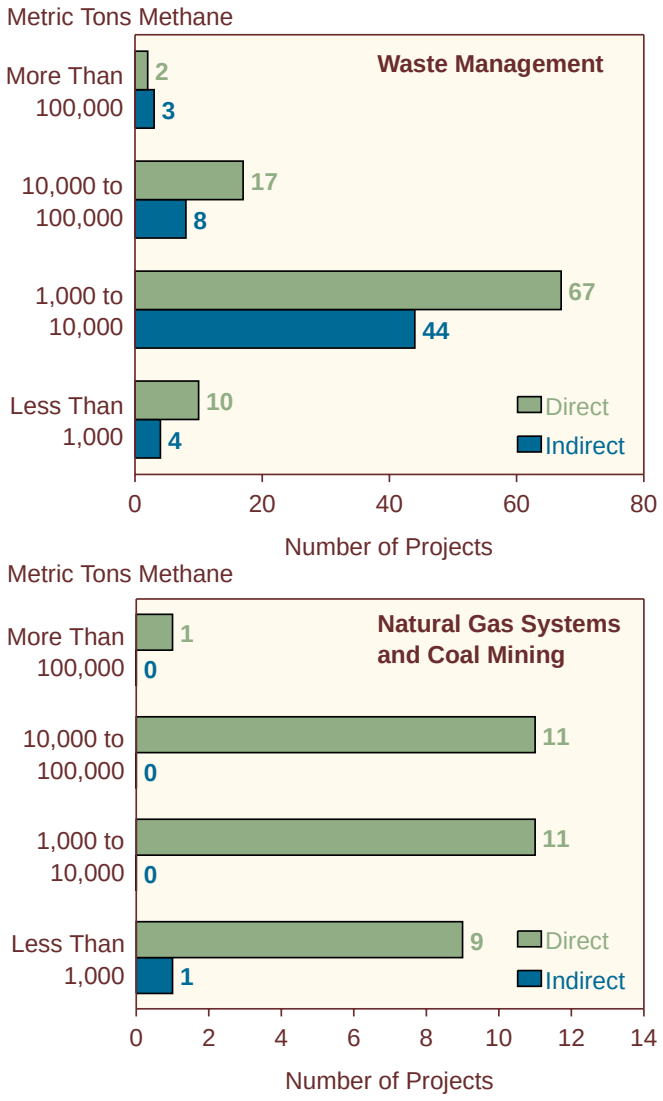
(R) = revised.
Note: Project totals do not equal sum of components, because some projects are counted in more than one category.
Source: Energy Information Administration, Form EIA-1605.

Table 17. Total Methane Emission Reductions Reported on Form EIA-1605, All Project Types, Data Years 1994-2001
(Metric Tons Methane)

Type of Reduction	1994	1995	1996	1997	1998	1999	2000(R)	2001
Direct	25,079	8,450	409,176	378,494	1,379,162	1,564,958	2,693,295	2,436,799
Indirect	102,641	1,077,272	1,157,048	505,663	658,811	827,294	897,465	1,009,400

(R) = revised.
Source: Energy Information Administration, Form EIA-1605.

Figure 13. Methane Emission Reduction Projects Reported on Form EIA-1605 by Type and Size of Reduction, Data Year 2001



Source: Energy Information Administration, Form EIA-1605.

the landfills for which reduction activities were reported on Form EIA-1605. In terms of the number of separate landfills involved in project reports, double reporting can also occur when a single entity reports methane flaring and methane recovery for energy at the same landfill as separate projects. There were two such cases among the Form EIA-1605 reports for 2001.

Reducing Methane Emissions from Waste Treatment and Disposal

Reducing emissions from waste treatment and disposal sites was by far the most frequently reported method for lowering methane emissions in 2001. The number of such projects reported on Form EIA-1605 for 2001 (208) made up 83 percent of all the methane emission reduction projects reported for the year. This was 17 more projects than were reported for 2000 (excluding late reports) and more than 12 times the number (17) reported for 1994. The principal reported method for reducing methane emissions from waste treatment and disposal was the capture of methane generated during the anaerobic decomposition of wastes in a landfill. The methane may be flared, piped to an end-use customer, or used to generate electricity, reducing the need for generation from other, more carbon-intensive fuels. Other methods of lowering emissions from waste treatment and disposal include reducing the volume of waste reaching landfills through combustion or recycling, and capturing methane generated during anaerobic decomposition of organic material in wastewater.

The 208 waste treatment and disposal projects reported for 2001 accounted for 1,007,485 metric tons of direct methane emission reductions and 1,003,287 metric tons of indirect reductions (Table 18). Of the 208 projects reported, 198 achieved methane emission reductions at landfills by capturing methane from landfill gas generated at waste disposal sites, 6 lowered emissions through diversion of wastes that would have emitted methane during decomposition, and 4 captured methane from wastewater treatment facilities.

Recovery of Landfill Gas

As waste decomposes in a landfill it produces a biogas that is approximately 50 percent carbon dioxide and 50 percent methane. As a result, landfill gas is a potentially valuable source of energy, with a heat content of about 500 British thermal units (Btu) per cubic foot, or about half that of commercially marketed natural gas. Because of its relatively low Btu content and the presence of several impurities, the typical method for using landfill gas is to burn it for electricity generation rather than upgrading it for sale to a pipeline. The electricity generated is then used on site or sold to the grid. The process lowers methane emissions and reduces consumption of other fuels for electricity generation. When the electricity generated displaces oil- or coal-fired generation, carbon dioxide emissions are reduced. More recently, an increasing number of projects have involved piping landfill gas for direct use in medium-Btu boilers, which also displaces fossil fuels.

For the 198 landfill gas recovery projects reported for 2001, reported direct methane emission reductions totaled 969,932 metric tons and indirect reductions totaled 701,901 metric tons methane. Of the projects reported, 100 recovered landfill methane for energy, 14 simply flared the gas, 77 included both recovery for energy and flaring, and 7 reported other activities.

Waste Diversion

When waste is diverted from a landfill through recycling, source reduction, or waste combustion, methane

emissions that would have resulted when the waste decomposed at a landfill are avoided. Six such projects were submitted to the Voluntary Reporting Programon Form EIA-1605 for 2001 under the category of waste treatment and disposal. The preponderance of the methane emission reductions reported for waste diversion are indirect, because they typically occur at a landfill where diverted waste would have decomposed to produce methane. Total indirect reductions for the six projects were 288,325 metric tons methane. The majority of the reductions were reported by IWSA, which reported reductions associated with the combustion of waste at facilities owned by its members across the United States. IWSA's total reported reduction of methane emissions in 2001 was 265,719 metric tons. There were also many recycling projects reported under project types other than waste treatment and disposal that showed reductions in methane emissions (see box on page 51).

Reducing Methane Emissions from Wastewater Treatment Plants

When wastewater is treated under anaerobic conditions, the decomposition of its organic portion yields methane. Like methane generated from waste at landfills, the methane generated from wastewater treatment may be captured and either flared or used as an energy resource. Because captured methane has value as an energy resource, operators may use an anaerobic digester to treat the wastewater and maximize methane generation. Four projects to capture methane generated from wastewater treatment were reported for 2001, with total reported direct reductions of 37,591 metric tons methane and indirect reductions of 13,060 metric tons methane. All the direct reductions were reported by a Los Angeles County Sanitation District project, and all the indirect reductions were reported for two projects sponsored by FirstEnergy.

Reducing Emissions from Energy Production and Consumption

Reducing Emissions from Coal Mines

As coal is formed from organic material by natural chemical and physical processes, methane is also created. The methane is stored in the pores (open spaces) of the coal itself and in cracks and fractures in the coalbed. As coal is mined, the pressure surrounding the stored methane decreases, allowing much of it to be released into the operating coal mine. Because methane in concentrations of 5 to 15 percent is explosive, mine operators use large fans to provide a steady airflow across the mine face and ventilate the mine shaft. Some very gassy mines must also employ degasification wells to remove methane before or after mining so that it does not enter the mine. Because methane is a valuable energy source, most of the mines with degasification systems now inject the methane into gas pipelines or use it to generate electricity or heat.

For 2001, 16 projects to reduce methane emissions from coal mines were reported on Form EIA-1605, with total direct emission reductions of 538,285 metric tons and indirect reductions of 96 metric tons methane (Table 19). U.S. Steel Mining Company reported direct methane reductions of 106,771 metric tons methane from its two projects, and El Paso Production Company reported direct reductions of 79,914 metric tons from its project in White Oak Creek coalbed in Alabama.

Reducing Emissions from Natural Gas Production, Transmission, and Distribution

Methane is the principal constituent of natural gas (about 95 percent of the mixture). Methane emissions

Table 18. Methane Emission Reductions from Waste Treatment and Disposal Projects Reported on Form EIA-1605, Data Years 1994-2001
(Metric Tons Methane)

Reduction and Project Type	1994	1995	1996	1997	1998	1999	2000(R)	2001
Direct Reductions	*	619	128,449	135,639	484,673	966,785	2,171,501	1,007,485
Landfill Gas Recovery	*	619	128,449	135,340	451,445	921,666	2,134,007	969,932
Wastewater Treatment	—	—	—	298	33,267	40,763	37,532	37,591
Waste Combustion	—	—	—	—	-39	4,356	-38	-38
Indirect Reductions	99,431	1,061,691	1,142,877	449,595	644,739	815,344	884,484	1,003,287
Landfill Gas Recovery	99,431	111,293	250,480	298,335	470,880	575,484	612,862	710,345
Wastewater Treatment	—	1	*	—	4,714	19,648	12,662	13,060
Waste Combustion	0	950,397	892,397	151,259	169,145	220,212	258,960	279,882

*Less than 0.5 metric ton.
(R) = revised.
Source: Energy Information Administration, Form EIA-1605.

Materials Management Projects

"Materials management" is a crosscutting category that can encompass a variety of greenhouse gas and emission sources, and may include any of the following activities:

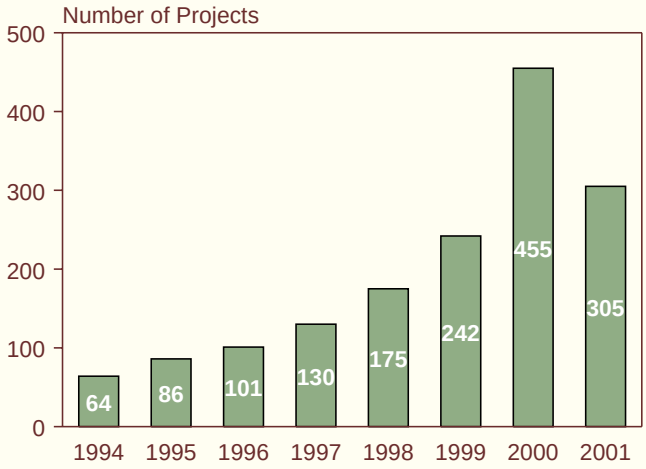
- Use of biomass fuels, such as wood waste, which reduces carbon dioxide emissions by displacing fossil fuels
- Avoidance of methane emissions from the decay of waste materials in landfills, wastewater treatment plants, and other waste management systems through activities such as recovery of methane from landfills or from anaerobic digesters treating municipal sewage, agricultural wastes, or animal manure, and diversion of municipal solid waste from landfills to waste-to-energy systems
- Recycling of halogenated substances, such as sulfur hexafluoride, hydrofluorocarbons, chlorofluorocarbons, and hydrochlorofluorocarbons
- Recycling and source reduction of solid waste, which reduce methane emissions from municipal landfills and reduce emissions of carbon dioxide and other gases associated with the production of virgin materials displaced by the materials recycled
- Reuse of coal ash as a substitute for Portland cement in concrete, which reduces carbon dioxide emissions from the manufacture of the cement.

Reporting of materials management activities on Form EIA-1605 increased sevenfold from 1994 to 2000. Only 305 projects were reported for 2001, 33 percent fewer than were reported for 2000 (see figure); however, Waste Management, Inc., submitted a late report for 2000 that added a large number of projects, and late reports will raise the project total for 2001.

Landfill gas recovery accounted for most (65 percent) of the 305 materials management projects reported for 2001. In addition to 12 other methane emission avoidance projects reported, other materials management projects included coal ash reuse (37), recycling and source reduction of solid waste (31), recycling of halogenated substances (16), and biomass burning (11).

The emission reductions reported for materials management projects are shown in the table below. For 2001, reported net reductions in direct emissions were 15.4 million metric tons carbon dioxide equivalent, representing 7 percent of the total direct reductions reported. Reported indirect reductions were 47.2 million metric tons carbon dioxide equivalent, representing 66 percent of the total indirect reductions reported.

Materials Management Projects Reported on Form EIA-1605, Data Years 1994-2001



Source: Energy Information Administration, Form EIA-1605.

Reported Emission Reductions from Materials Management Projects by Project Type and Type of Reduction, Data Year 2001
(Metric Tons Carbon Dioxide Equivalent)

Project Type	Number of Projects	Direct Reductions	Indirect Reductions
Biomass Burning	11	462,901	107,633
Methane Emission Avoidance			
Landfill Gas Recovery	198	22,062,248	16,979,711
Municipal Waste Combustion	7	-9,454,425	23,632,655
Wastewater Treatment	4	859,918	293,604
Agricultural Waste	1	148	1,433
Total	*210*	*13,467,889*	*40,907,404*
Halogenated Substances	16	1,123,904	81
Recycling and Source Reduction of Solid Waste	31	362,733	789,941
Coal Ash Reuse	37	0	5,370,767
Total	**305**	**15,417,426**	**47,175,827**

Source: Energy Information Administration, Form EIA-1605.

from natural gas production, processing, transmission, and distribution are generally process related, with normal operations, routine maintenance, and system upsets being the primary contributors. Emissions vary greatly from facility to facility and are largely a function of operation and maintenance procedures and equipment conditions. Thus, methane emissions can be reduced by replacing leaky system components, improving operations and maintenance, and limiting routine venting procedures. Nineteen such projects were reported for 2001, with total direct emission reductions of 119,609 metric tons methane. No indirect reductions were reported. Two of NIPSCO's Natural Gas STAR projects were responsible for 91,657 metric tons of direct methane emission reductions, or 77 percent of the total for natural gas projects.

Reducing Emissions from Agriculture

Three projects reported for 2001 focused on reducing methane emissions from agricultural activities, but only two of them reported emission reductions. As the purchaser of the electricity from one project, FirstEnergy reported indirect methane emission reductions of 71 metric tons from Mason Dixon Farms. AES reported an indirect reduction of 915 metric tons methane from improving feed supplements for cattle in India and reducing emissions from enteric fermentation. The remaining project was a study on reducing emissions from rice cultivation, financed by Reliant Energy (formerly Houston Lighting and Power Company), for which reductions were not estimated.

Federal Voluntary Programs To Reduce Methane Emissions

The U.S. Government sponsors a number of voluntary programs specifically targeted to reduce methane emissions. Most frequently cited by reporters to the Voluntary Reporting Program are the Landfill Methane Outreach Program (LMOP), the Coalbed Methane Outreach Program (CMOP), and the Natural Gas STAR Program. In addition, reducing methane is an effective method for meeting the reduction targets adopted by utilities under the Climate Challenge voluntary program. The number of reported methane reduction projects associated with Federal voluntary programs has increased nearly eightfold since 1994, with a particularly large increase in the number of projects associated with the LMOP. Of the 208 waste treatment and disposal projects reported to the Voluntary Reporting Program for 2001, 176 (85 percent) were associated with the LMOP (Table 20).

Table 19. Methane Emission Reductions from Natural Gas Systems and Coal Mining Reported on Form EIA-1605, Data Years 1994-2001
(Metric Tons Methane)

Reduction and Project Type	1994	1995	1996	1997	1998	1999	2000(R)	2001
Direct Reductions	**19,687**	**7,714**	**279,766**	**242,040**	**893,927**	**595,311**	**518,590**	**657,894**
Coal Mining	13,767	4,191	271,549	232,131	885,807	581,307	505,941	538,285
Natural Gas Systems	5,920	3,522	8,217	9,909	8,121	14,004	12,648	119,609
Indirect Reductions	**—**	**3,543**	**4,039**	**5,439**	**7,603**	**6,565**	**6,785**	**96**
Coal Mining	—	278	893	2,285	1,568	528	747	96
Natural Gas Systems	—	3,265	3,146	3,154	6,035	6,036	6,038	0

(R) = revised.
Source: Energy Information Administration, Forms EIA-1605 and EIA-1605EZ.

Table 20. Number of Reported Methane Reduction Projects Associated with Other Federal Voluntary Programs, Data Years 1994-2001

Voluntary Program	1994	1995	1996	1997	1998	1999	2000(R)	2001
Climate Challenge	22	27	32	36	34	39	42	34
Landfill Methane Outreach Program	6	8	29	32	90	116	309	176
Coalbed Methane Outreach Program	1	1	2	2	10	11	6	9
Natural Gas STAR	7	9	11	6	5	7	7	14
Other	0	6	2	2	1	3	4	5
Total	**30**	**42**	**64**	**65**	**132**	**164**	**354**	**224**

(R) = revised.
Note: Totals may not equal sum of components, because some projects are associated with more than one voluntary program.
Source: Energy Information Administration, Form EIA-1605.

6. HFCs, PFCs, and Sulfur Hexafluoride

U.S. Emissions of HFCs, PFCs, and Sulfur Hexafluoride

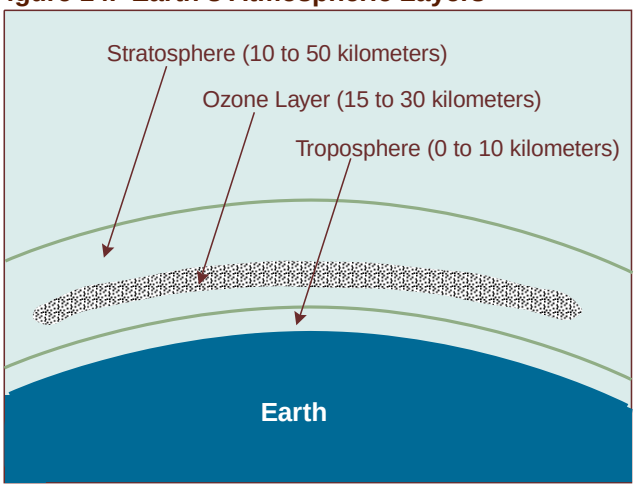
Halogenated substances are chemicals that have been engineered for a variety of industrial uses. Some are greenhouse gases with high global warming potentials (GWPs) as compared with carbon dioxide and, therefore, may have an effect on global climate disproportionate to the relatively small volumes emitted.[39] Emissions of halogenated substances can be classified into two groups according to the accuracy with which their GWPs can be determined.

The first group consists of chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs), and other chlorine-containing gases. These compounds absorb infrared radiation at wavelengths that would not otherwise be absorbed, making them potent greenhouse gases with direct radiative forcing effects hundreds or thousands of times greater than that of carbon dioxide. Because they contain chlorine, however, these substances also tend to destroy the ozone layer, located in the middle to upper stratosphere (Figure 14), which absorbs damaging ultraviolet radiation from the sun. Because ozone is a greenhouse gas, the reaction tends to offset the net warming effects of the chlorine-containing halogens to varying degrees. As a result, their effective GWPs are difficult to determine.

CFC production ceased in January 1996 in accordance with the Copenhagen Amendments to the Montreal Protocol (except for production of CFCs used in metered dose inhalers for asthma patients). In addition, all HCFC production is required to be phased out by 2030. The United Nations Framework Convention on Climate Change (UNFCCC) excludes from its provisions gases covered by the Montreal Protocol and, therefore, does not address CFCs and HCFCs.

The halogenated substances in the second group, which are the focus of this chapter, include hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6). These compounds also absorb infrared radiation that would not otherwise be absorbed in the troposphere, and they have relatively high radiative forcing impacts. In contrast to the chlorine-containing halogenated substances, these compounds do not destroy ozone. Thus, their estimated GWPs, expressed in metric tons carbon dioxide equivalent, can be more accurately evaluated. The Kyoto Protocol to the UNFCCC explicitly lists HFCs, PFCs, and SF_6 as greenhouse gases affected by its provisions.

Figure 14. Earth's Atmospheric Layers



Source: U.S. Environmental Protection Agency.

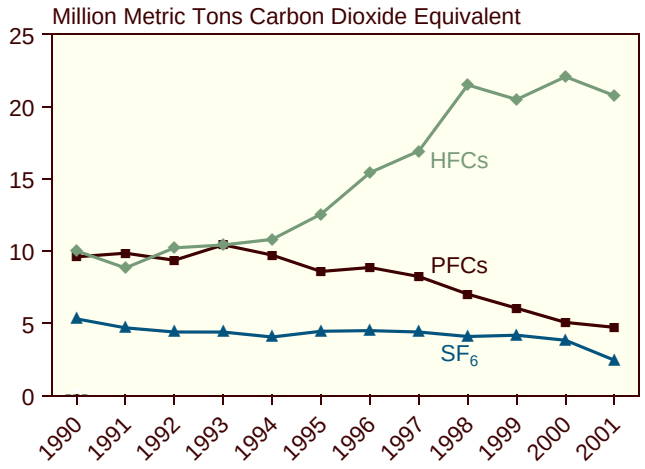
In 2001, U.S. emissions of HFCs, PFCs, and SF_6 were estimated to be 115.3 million metric tons carbon dioxide equivalent, a 26-percent increase over 1990 levels, primarily due to increases in HFC emissions.[40] Emissions of HFCs, which are used as replacements for CFCs as blowing agents, refrigerants, solvents, and in automobile air conditioners, overall have been growing since 1990 (Figure 15). In turn, emissions of CFCs are decreasing, according to recent estimates published by the Energy Information Administration.[41] PFCs are emitted as a byproduct of aluminum smelting and are used in semiconductor manufacturing as etchants and cleaning agents. Emissions of PFCs have remained relatively stable since 1990, and emissions of SF_6 have been declining.

[39]Global warming potentials from Intergovernmental Panel on Climate Change, *Climate Change 2001: The Scientific Basis* (Cambridge, UK: Cambridge University Press, 2001), Table 6.7, pp. 388-389.

[40]Energy Information Administration, *Emissions of Greenhouse Gases in the United States 2001*, DOE/EIA-0573(2001) (Washington, DC, December 2002), web site www.eia.doe.gov/oiaf/1605/1605a.html.

[41]Energy Information Administration, *Emissions of Greenhouse Gases in the United States 2001*, DOE/EIA-0573(2001) (Washington, DC, December 2002), web site www.eia.doe.gov/oiaf/1605/1605a.html. Estimates of CFC, HFC, PFC, and SF_6 emissions are based on data obtained from the U.S. Environmental Protection Agency.

Figure 15. Estimated U.S. Emissions of HFCs, PFCs, and Sulfur Hexafluoride, 1990-2001



Source: Energy Information Administration, *Emissions of Greenhouse Gases in the United States 2001*, DOE/EIA-0573(2001) (Washington, DC, December 2002), Table 30, p. 71.

Projects Reported

For the 2001 data year, 33 entities reported on 58 projects that reduced emissions of halogenated substances, 1 less reporter and 5 fewer projects than were reported for 2000. Thirty-one of the 33 entities reporting in this category reported on 55 projects, 17 of which included direct reductions in SF_6 emissions. Three entities reported on projects with zero direct reductions in SF_6 emissions. Four entities reported on projects that included direct reductions of PFC emissions. One entity reported on a project to reduce emissions of HFC-134a (tetrafluoroethane) but provided no data on reductions for 2001. Eighteen of the 33 entities reporting in this category reported on projects that included reductions in emissions of PFCs (perfluoroethane and perfluoromethane). One entity also reported a project with zero reductions of PFC emissions.

Twenty-seven of the 33 entities reporting projects that reduced emissions of halogenated substances for 2001 were electric utilities; two were aluminum smelters (Alcan Primary Metals Group–Sebree Works and Noranda Aluminum, Inc.); one was from the electronic equipment industry (Lucent Technologies, Inc.); and one was a local government in New York State (Madison County Department of Solid Waste & Sanitation).

Nineteen of the 27 electric utilities that reported projects in this category were participants in the Climate Challenge Program sponsored by the U.S. Department of Energy (DOE). Other voluntary programs with which the projects reported in this category were affiliated include the Voluntary Aluminum Industrial Partnership, the Energy Star Programs, Rebuild America, and the Sulfur Hexafluoride Emissions Reduction Partnership for Electric Power Systems.

For 2001, emissions avoidance and recycling were the two most frequently reported project types (23 and 16 projects reported, respectively), followed by substitution of other chemicals (6 projects reported) and the destruction of halogenated substances (1 project reported). Reductions in PFC emissions were also reported for 19 post-consumer waste recycling projects in which aluminum was one of the materials collected and recycled (Table 21).

Direct reductions of HFC, PFC, and SF_6 emissions were reported by 20 entities for 22 projects, totaling 6,081,957 metric tons carbon dioxide equivalent (Table 22), and 1 entity reported a project that included direct reductions of HFC emissions but did not provide data for 2001. Also for 2001, 14 entities reported on projects that included indirect reductions of PFC emissions totaling 34,400 metric tons carbon dioxide equivalent, and another

Table 21. Number of Projects Reported on Form EIA-1605 for Halogenated Substances, Data Years 1994-2001

Project Type	1994	1995	1996	1997	1998	1999	2000	2001
General	0	1	0	1	0	0	0	0
Reclamation: Recycling	7	10	10	14	15	15	18	16
Reclamation: Destruction	0	0	1	1	0	1	1	1
Substitution	1	5	7	7	8	9	9	6
Emissions Avoidance	3	6	8	13	17	16	23	23
Use of Improved Appliances	0	1	1	1	1	1	1	0
Other Projects/Activities	1	1	0	0	0	0	0	0
PFC Reductions from Materials Recycling	0	0	0	4	7	10	20	19
Total Number of Projects	**13**	**21**	**22**	**33**	**42**	**46**	**63**	**58**

Note: Project totals may not equal sum of components because some projects may be counted in more than one category.
Source: Energy Information Administration, Form EIA-1605.

entity reported indirect reductions of SF_6 emissions that amounted to 81 metric tons carbon dioxide equivalent.

Emission Reductions by Gas

Reported direct reductions of PFC emissions totaled 3.6 million metric tons carbon dioxide equivalent and accounted for the highest percentage (59 percent) of direct reductions in emissions of halogenated substances reported for 2001. This reflects an increase over the amounts reported for 2000 (Table 23), primarily because of the increased use of HCFCs and HFCs as replacements for CFCs. Reported direct reductions of SF_6 emissions for 2001 increased by 1.4 million metric tons carbon dioxide equivalent (76 percent) from those reported for 2000 and were almost 30 times the value reported for 1994 (Table 23). Consolidated Edison of New York, Inc., Southern Company, and TXU together accounted for 71 percent of the total reported direct reductions in SF_6 emissions for 2001 and 29 percent of the total reported direct reductions of HFCs, PFCs, and SF_6 emissions combined.

Hydrofluorocarbons

HFCs are used as replacements for ozone-depleting substances such as CFCs. U.S. emissions of HFCs were

Table 22. Reductions of Hydrofluorocarbon, Perfluorocarbon, and Sulfur Hexafluoride Emissions Reported on Form EIA-1605, Data Year 2001

	Emission Reductions Reported			
	Metric Tons of Gas		Metric Tons Carbon Dioxide Equivalent	
Gas	Direct	Indirect	Direct	Indirect
HFC-134a	0	—	0	—
HFC-152a	—	—	—	—
Perfluoromethane	523	5	2,982,917	29,115
Perfluoroethane	52	*	623,896	5,205
Sulfur Hexafluoride	111	*	2,475,144	81
Total	**NA**	**NA**	**6,081,957**	**34,400**

*Less than 0.5 metric tons.
NA = not applicable. — = none reported.
Sources: Energy Information Administration, Form EIA-1605. Global warming potentials from Intergovernmental Panel on Climate Change, *Climate Change 2001: The Scientific Basis* (Cambridge, UK: Cambridge University Press, 2001), Table 6.7, pp. 388-389.

Table 23. Reductions in Emissions of Halogenated Substances Reported on Form EIA-1605 by Type of Reduction, Data Years 1994-2001
(Metric Tons of Gas)

Gas and Reduction Type	1994	1995	1996	1997	1998	1999	2000	2001
HFC-134a								
Direct	**	**	**	**	-1	-1	0	—
Indirect	—	—	—	—	—	—	—	—
HFC-152a								
Direct	—	—	127	0	0	0	—	—
Indirect	—	—	—	—	—	—	—	—
Perfluoromethane								
Direct	466	431	486	482	507	498	470	523
Indirect	—	—	—	1	1	1	5	5
Perfluoroethane								
Direct	46	42	48	48	52	49	47	52
Indirect	—	—	—	*	*	*	1	*
Sulfur Hexafluoride								
Direct	4	8	-3	23	28	27	63	111
Indirect	—	*	—	*	*	*	*	*

*Greater than zero but less than 0.5 metric tons of gas.
**Greater than -0.5 but less than zero metric tons of gas.
— = none reported.
Source: Energy Information Administration, Form EIA-1605.

estimated at 77 million metric tons carbon dioxide equivalent in 2001, a 110-percent increase over 1990 levels.[42] HFCs are used to replace CFCs as blowing agents, in automobile air conditioners and refrigerators, and in other manufacturing applications, where emissions result from system leaks. In the semiconductor industry, HFCs are also used in plasma etching and chemical vapor deposition processes. HFC-23 is a byproduct of HCFC-22 manufacturing. The Tennessee Valley Authority, reported on a project that included direct reductions of HFC-134a, but for which no reduction data have been available since 1998.

Perfluorocarbons

The principal source of PFC emissions is aluminum smelting. PFCs are produced during aluminum production when the alumina content of the electrolytic bath falls below critical levels required by the electrolytic effect. The resulting electrical upset in the reduction cell is manifested as a rapid voltage increase. The gases formed accumulate at the anode of the reduction cell (hence the name "anode effect"). PFCs are also used in some semiconductor manufacturing processes and, consequently, may be emitted from fabrication plants.

For 2001, two companies (Alcan Primary Metals Group–Sebree Works and Noranda Aluminum, Inc.) reported reductions in emissions of PFCs totaling 3,604,919 metric tons carbon dioxide equivalent, which accounted for 59 percent of total reported project-level direct reductions in emissions of PFCs, HFCs, and SF_6 in 2001 (Table 22). During 2001, efforts by Noranda to reduce PFC emissions were focused on controlling the amount of alumina in solution to avoid anode effects and monitoring the process more closely to stop or correct them expeditiously. According to Noranda's report, perfluoromethane emissions were reduced by 2,616,300 metric tons carbon dioxide equivalent and perfluoroethane emissions by 547,400 metric tons carbon dioxide equivalent. Alcan reported direct reductions in perfluoromethane emissions totaling 365,011 metric tons carbon dioxide equivalent and direct reductions in perfluoroethane emissions totaling 76,208 metric tons carbon dioxide equivalent. Additionally, City Public Service and Los Angeles Department of Water and Power reported materials recycling projects (see box in Chapter 5, page 53) that included direct reductions of PFC emissions totaling 1,895 metric tons carbon dioxide equivalent.

The U.S. Environmental Protection Agency sponsors the Voluntary Aluminum Industrial Partnership, which seeks to reduce emissions of PFCs, carbon tetrachloride, and SF_6 during primary aluminum processing. For 2001, both Alcan and Noranda reported participation in the program.

Sulfur Hexafluoride

Sulfur hexafluoride is used as an insulator for circuit breakers, switch gear, and other electrical equipment and as a cover gas in magnesium smelting. It is also emitted during the aluminum smelting process. It has a very high GWP—22,200 times the warming effect of carbon dioxide per ton emitted. Therefore, even small amounts of SF_6 can play a disproportionate role in U.S. contributions to climate change.[43]

For 2001, 16 companies—including Consolidated Edison of New York, Inc., Southern Company, FirstEnergy Corporation, TXU, and Southern California Edison—claimed direct reductions in SF_6 emissions that totaled 2,475,144 metric tons carbon dioxide equivalent, accounting for 41 percent of the total reported project-level direct reductions in emissions of PFCs, HFCs, and SF_6 (Table 22).

All of the largest reductions in SF_6 emissions reported for 2001 were direct emission reductions. Consolidated Edison of New York, Inc., reported the largest single reduction in SF_6 emissions for 2001 at 1,081,872 metric tons carbon dioxide equivalent, followed by the Southern Company (421,800 metric tons), TXU (257,125 metric tons), and FirstEnergy Corporation (167,057 metric tons). These four project-level claims of emission reductions combined to account for 78 percent (1,927,854 metric tons carbon dioxide equivalent) of total reported project-level direct reductions of SF_6 emissions for 2001 and 32 percent of total project-level direct emission reductions claimed for HFCs, PFCs, and SF_6 combined (Table 24).

[42]Energy Information Administration, *Emissions of Greenhouse Gases in the United States 2001*, DOE/EIA-0573(2001) (Washington, DC, December 2002), web site www.eia.doe.gov/oiaf/1605/1605a.html.

[43]Energy Information Administration, *Emissions of Greenhouse Gases in the United States 2001*, DOE/EIA-0573(2001) (Washington, DC, December 2002), web site www.eia.doe.gov/oiaf/1605/1605a.html.

Table 24. Largest Project-Level Direct Reductions of Sulfur Hexafluoride Emissions Reported on Form EIA-1605 by Reporter, Data Year 2001

Reporter	SF_6 Direct Emission Reductions Reported		Percent of Total Reported Direct Reductions of HFCs, PFCs, and SF_6 Emissions
	Metric Tons of Gas	Metric Tons Carbon Dioxide Equivalent	
Consolidated Edison Company of New York, Inc.	48.7	1,081,872	17.8
Southern Company	19.0	421,800	6.9
TXU	11.6	257,125	4.2
FirstEnergy Corporation	7.5	167,057	2.7
Southern California Edison Co.	6.0	132,681	2.2
American Electric Power, Inc.	4.4	97,678	1.6
FPL Group	4.1	91,566	1.5
PG&E Corporation	3.8	83,384	1.4
NiSource/NIPSCO	2.3	50,349	0.8
Tucson Electric Power Company	1.9	41,226	0.7
Niagara Mohawk Power Corporation	1.6	35,829	0.6
City Public Service	0.3	7,522	0.1
Reported Total	**111.5**	**2,475,144**	**40.7**

Note: Totals may not equal sum of components due to independent rounding.

Sources: Energy Information Administration, Form EIA-1605. Global warming potentials from Intergovernmental Panel on Climate Change, *Climate Change 2001: The Scientific Basis* (Cambridge, UK: Cambridge University Press, 2001), Table 6.7, pp. 388-389.

7. Entity-Level Reporting and Future Commitments

Overview

The Voluntary Reporting Program permits three distinct types of emissions reporting:

- Entity-level emissions and reductions, defined as the emissions and reductions of an entire organization, usually defined as a corporation
- Project-level emissions and reductions, defined as the emission reductions consequences of a particular action
- Commitments to take action to reduce emissions in the future.

Chapters 2 through 6 of this report cover project-level emissions. This chapter covers entity-level emissions, emission reductions, and commitments to reduce emissions in the future. Entity reporting and project reporting are not mutually exclusive. They correspond to different views of the appropriate answer to the question, "What is a reduction?" Most (179, or 79 percent) of the 228 participants in the program for the 2001 data year reported project-level information on emissions and/or reductions, and 109 (48 percent) reported entity-level information. Sixty-one (27 percent) of all the participants in the program reported both entity-level information and project-level information. Thus, 56 percent of the entity-level reporters also chose to report project-level information on emissions and/or emission reductions. Forty-eight firms (21 percent of reporters) reported entity-level information only, whereas 118 (52 percent) submitted only project-level information. In addition, 85 entities, or 38 percent of all participants in the program, reported formal commitments to reduce future greenhouse gas emissions, to take action to reduce emissions in the future, or to provide financial support for activities related to greenhouse gas reductions.

Entity-Level Reporting

Who Reported

Electric power producers accounted for 41 of the 109 entity-level reporters. They included American Electric Power, the Southern Company, the Tennessee Valley Authority (TVA), and most of the largest electric utilities in the United States. In addition, three subsidiaries of the AES Corporation (an independent power producer) reported on domestic power plants with emissions offset by international forestry projects. The remaining 68 entity-level reporters included aluminum smelters (Alcan Primary Metals Group–Sebree Works, and Columbia Falls Aluminum), two semiconductor manufacturers (Lucent Technologies, Inc., and Motorola Austin), and several large manufacturers (Ford, GM, IBM, Johnson & Johnson, and Rolls-Royce Corporation). Also reporting at the entity level were cement manufacturers (including two plants of the California Portland Cement Company, as well as Lehigh Cement Company and Arizona Portland Cement Company), an oil company (Sunoco, Inc.), a chemical company (Dow Chemical Company), an aircraft manufacturer (Sikorsky Aircraft Corporation), a trade association (Integrated Waste Services Association [IWSA]), the Miller Brewing Company, Bethlehem Steel Corporation, and one household.

Reported Emissions

Total 2001 entity-level direct emissions of greenhouse gases reported to the Voluntary Reporting Program were 903 million metric tons carbon dioxide equivalent or 13 percent of total estimated U.S. emissions of greenhouse gases.[44] Total 2001 entity-level indirect emissions reported to the program were 147 million metric tons carbon dioxide equivalent, or 2 percent of total estimated U.S. emission of greenhouse gases. Reported entity-level direct carbon dioxide emissions for 2001 were 877 million metric tons, which represented 97 percent of reported direct emissions— weighted by global warming potential (GWP).

The single largest category of direct emissions reported was the 869 million metric tons carbon dioxide emitted by stationary combustion sources, mostly electric utilities, which represented 99 percent of the total direct carbon dioxide emissions reported for 2001 (Table 25). The largest direct emissions reported were from the Miller Brewing Company, with emissions of 107 million metric tons carbon dioxide (Table 26). The second largest direct emissions reported were from Tennessee Valley Authority, with emissions of 80 million metric tons carbon dioxide, followed by Cinergy Corporation (58 million metric tons), Duke Energy Corporation (55 million metric tons), and FPL Group (52 million metric tons). In addition, PacifiCorp, Entergy Services Inc., DTE Energy/Detroit

[44]Energy Information Administration, *Emissions of Greenhouse Gases in the United States 2001*, DOE/EIA-0573(2001) (Washington, DC, December 2002), web site web site www.eia.doe.gov/oiaf/1605/1605a.html.

Edison, FirstEnergy Corporation, Reliant Energy-HLP, PG&E Corporation, and Florida Power Corporation each reported direct emissions of carbon dioxide in the range of 23 to 47 million metric tons for 2001.

Carbon dioxide also accounted for 97 percent of reported indirect emissions of greenhouse gases weighted by GWP. The single largest category of reported indirect emissions for 2001 was 142 million metric tons carbon dioxide resulting from the reporting entities' purchased power transactions. Manufacturers that purchase electricity usually view themselves as responsible for the electricity they consume and, consequently, for any reductions in the quantity of electricity consumed. Utilities, however, have adopted more diverse views. Most electric utilities view themselves as responsible only for the direct emissions from their stacks. This view is unambiguous, relatively easy to verify, and prevents the same emission from being reported by more than one utility; however, accounting for reductions in emissions caused by substitutions of purchased power for company-generated power adds complexity to the picture.

Some utilities (for example, Hawaiian Electric Company, Portland General Electric, and Niagara Mohawk Corporation) viewed themselves as responsible for their direct emissions plus the indirect emissions from electricity purchases necessary to support their customer base. This approach accounts for the possibility that a decline in generation may be associated with an increase in power purchases, but it may create the appearance of an increase in emissions when a firm is both buying and

Table 25. Total Reported Entity-Level Carbon Dioxide Emissions by Type and Source, Data Year 2001
(Million Metric Tons Carbon Dioxide Equivalent)

Type of Reduction and Emissions Source	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Direct Emissions												
Stationary Combustion	722.1	582.4	679.8	717.1	737.2	881.7	884.2	934.5	991.2	1,430.0	1,006.3	868.5
Transportation	0.6	0.1	0.1	0.1	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.7
Other Direct Sources	3.8	5.8	7.4	7.8	8.0	7.8	8.3	7.7	7.6	7.8	7.7	7.5
Total Direct	**726.5**	**588.4**	**687.3**	**725.1**	**745.8**	**890.1**	**893.1**	**942.8**	**999.4**	**1,438.4**	**1,014.5**	**876.7**
Indirect Emissions												
Purchased Power	67.7	62.0	58.7	64.8	65.2	115.0	116.9	159.3	129.3	133.8	149.9	141.9
Other Indirect Emissions	374.2	365.3	369.4	370.5	372.0	366.6	360.3	352.8	345.5	341.0	0.5	0.5
Total Indirect	**441.9**	**427.3**	**428.1**	**435.3**	**437.3**	**481.6**	**477.2**	**512.1**	**474.8**	**474.8**	**150.4**	**142.4**
Electricity Wholesaling	8.0	13.5	8.1	7.0	4.2	5.7	-3.9	-51.3	-32.2	-24.5	-14.7	-12.7

Source: Energy Information Administration, Form EIA-1605.

Table 26. Largest Reported Entity-Level Direct Carbon Dioxide Emissions by Reporter and Source, Data Year 2001

Reporter	Emissions Source	Reported Direct Carbon Dioxide Emissions (Million Metric Tons)	Percentage of Total Reported Direct Emissions of All Greenhouse Gases
Miller Brewing Company	Stationary Combustion	107.1	12.2
Tennessee Valley Authority	Stationary Combustion	80.1	9.1
Cinergy Corp.	Stationary Combustion	57.8	6.6
Duke Energy Corporation	Stationary Combustion	54.9	6.3
FPL Group	Stationary Combustion	51.8	5.9
PacifiCorp	Stationary Combustion	46.8	5.3
Entergy Services, Inc.	Stationary Combustion	45.0	5.1
DTE Energy/ Detroit Edison	Stationary Combustion	39.6	4.5
FirstEnergy Corporation	Stationary Combustion	36.9	4.2
Reliant Energy - HL&P	Stationary Combustion	35.9	4.1
The Dow Chemical Company	Stationary Combustion	26.2	3.0
PG&E Corporation	Stationary Combustion	23.3	2.7
Florida Power Corporation	Stationary Combustion	22.8	2.6
NiSource/NIPSCO	Stationary Combustion	20.1	2.3
Total		**648.2**	**73.9**

Source: Energy Information Administration, Form EIA-1605.

selling (i.e., trading) increasing volumes of wholesale electricity. Also, double reporting is possible, because both the buyer and seller of the electricity may claim ownership.

Some utilities (for example, DTE Energy / Detroit Edison) also report a "net" view, in which they calculate direct generation emissions plus indirect electricity purchase emissions, minus emissions from "wholesale" electricity sales to other utilities. This approach captures net emissions to supply an end-use customer base, but there is greater potential for double counting, because double reporting is possible for both buying and selling. Further, "generation only" electricity producers, such as independent power producers or generation and transmission cooperatives, would be in the position of defining essentially all their direct emissions as belonging to their customers.

Any organization that reports indirect emissions and reductions is presented with a methodological problem: because the reporter does not control the source of emissions, the reporter may not have sufficient information to estimate emissions accurately. In the case of power purchases, firms that buy electricity may not always know precisely what emissions are associated with their purchases. Most reporters, however, reported only direct emissions. For those who reported indirect emissions, with a few exceptions, the impact of indirect emissions was generally small in comparison with the magnitude of direct emissions. Only a few companies reported direct emissions of other greenhouse gases at the entity level.

Reported direct emissions of gases other than carbon dioxide included 24 million metric tons carbon dioxide equivalent of methane, 1 million metric tons carbon dioxide equivalent of hydrofluorocarbons (HFCs), and less than 1 million metric tons carbon dioxide equivalent of sulfur hexafluoride. Reported direct emissions of nitrous oxide and perfluorocarbons (PFCs), were less than 1 million metric tons carbon dioxide equivalent each (Table 27).

Eleven companies reported entity-level direct emissions of methane for 2001, including Consol Coal Group, Jim Walter Resources, Inc., Peabody Holding Company, Inc., Dow Chemical Company, and Duke Energy Corporation. These five entities together accounted for 89 percent of total reported entity-level direct emissions of other greenhouse gases for 2001 (Table 28). Only three participants in the program, Dow Chemical Company, Rochester Gas & Electric Company, and IWSA, reported direct emissions of nitrous oxide for 2001. The direct emissions of nitrous oxide reported by these three entities together accounted for less than 0.5 percent of total reported entity-level direct emissions of other greenhouse gases for 2001. In addition, one reporter (Alcan Primary Metals Group–Sebree Works) accounted for all direct emissions of perfluorocarbon reported, and five companies (Dow Chemical Company, NiSource / NIPSCO, Public Service Enterprise Group, Sacramento Municipal Utility District, and Southern Company) reported direct emissions of sulfur hexafluoride. Emissions of sulfur hexafluoride reported by these five companies together accounted for 2 percent of total reported

Table 27. Total Reported Entity-Level Emissions of Other Greenhouse Gases by Type of Emissions, Data Year 2001
(Million Metric Tons Carbon Dioxide Equivalent)

Gas and Type of Emissions	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Methane												
Direct	52.7	17.9	18.2	13.9	31.9	32.9	29.5	31.2	31.4	26.2	24.8	24.3
Indirect	2.1	2.1	2.1	2.1	2.0	1.9	1.9	1.8	1.7	1.6	0.4	0.4
Nitrous Oxide												
Direct	*	*	*	*	*	*	*	*	*	*	0.7	*
Indirect	17.3	18.1	19.0	19.8	20.5	20.4	19.9	19.3	18.6	17.9	*	*
Hydrofluorocarbons												
Direct	*	*	*	*	*	*	*	*	0.1	0.1	0.1	1.1
Indirect	*	*	*	0.2	0.7	1.3	1.8	2.3	2.8	3.3	3.8	3.9
Perfluorocarbons												
Direct	0.6	0.6	0.6	0.6	0.3	0.3	0.3	0.3	0.2	0.1	0.2	0.2
Sulfur Hexafluoride												
Direct	0.4	0.5	0.5	0.5	0.7	1.7	1.7	1.4	1.1	0.6	0.7	0.6
Total												
Direct	**53.7**	**19.0**	**19.3**	**14.9**	**32.9**	**34.9**	**31.5**	**33.0**	**32.7**	**27.1**	**26.4**	**26.2**
Indirect	**19.5**	**20.2**	**21.1**	**22.1**	**23.2**	**23.6**	**23.5**	**23.3**	**23.1**	**22.9**	**4.2**	**4.3**

*Less than 0.05 million metric tons.
Source: Energy Information Administration, Form EIA-1605.

entity-level direct emissions of other greenhouse gases for 2001.

Reported Reductions

Entity-level reductions were, in general, much smaller than the corresponding emissions reported by participants in the Voluntary Reporting Program. Reported entity-level direct reductions totaled 169 million metric tons carbon dioxide equivalent for 2001, or 19 percent of all reported entity-level direct emissions. Reported entity-level indirect reductions totaled 28 million metric tons carbon dioxide equivalent, or 19 percent of all reported entity-level indirect emissions.

Reported entity-level direct emission reductions of carbon dioxide for 2001 totaled 117 million metric tons carbon dioxide (Table 29), equal to 2 percent of estimated total U.S. greenhouse gas emissions, and reported indirect emission reductions of carbon dioxide totaled 19 million metric tons. Reported direct reductions in emissions of other greenhouse gases for 2001 totaled 52 million metric tons carbon dioxide equivalent, and indirect emissions of other greenhouse gases totaled 10 million metric tons (Table 30).

The largest single direct reduction reported for 2001 was by TVA at 27 million metric tons carbon dioxide (direct reductions from stationary combustion sources), followed by Consol Coal Group at 19 million metric tons carbon dioxide equivalent and PG&E Corporation at 18 million metric tons carbon dioxide equivalent (reductions of methane emissions from other direct sources), followed by Niagara Mohawk Corporation at 15 million metric tons carbon dioxide, Duke Energy Corporation at 14 million metric tons carbon dioxide, and FirstEnergy Corporation at 14 million metric tons carbon dioxide equivalent (direct reductions from stationary combustion sources). These six entity-level claims of reductions in direct emissions combined accounted for 63 percent (107 million metric tons) of total reported entity-level claims of direct emission reductions for 2001 (Table 31).

Most of the emission reductions reported were direct reductions attributable to energy-related carbon dioxide, although IWSA reported that its members' combustion of municipal solid waste reduced indirect emissions of carbon dioxide by 15 million metric tons and indirect emissions of methane by 6 million metric tons carbon dioxide equivalent. In addition, Southern Company and FPL Group reported indirect reductions of carbon dioxide emissions at 2 million metric tons each (Table 32). These reductions combined to account for 26 million metric tons carbon dioxide equivalent or 90 percent of total reported indirect emission reductions at the entity level for 2001.

Most of the larger reported reductions (direct and indirect) were computed on the basis of "modified" reference cases—i.e., the reporter indicated that emissions were lower than they would have been without the actions taken (Tables 31 and 32). TVA, for example, used a generation planning model to calculate what its emissions from 1990 through 2001 would have been if it had used the set of generating units operational in 1990 at the 1990 capacity factors and heat rates. Since 1990, TVA has greatly expanded nuclear generation. Browns Ferry

Table 28. Largest Reported Entity-Level Direct Emissions of Other Greenhouse Gases by Reporter and Emissions Source, Data Year 2001

Reporter	Gas	Emissions Source	Reported Direct Emissions (Thousand Metric Tons Carbon Dioxide Equivalent)	Percentage of Total Reported Direct Emissions of Other Greenhouse Gases
Consol Coal Group	Methane	Other Direct	12,625.7	48.2
Jim Walters Resources, Inc.	Methane	Other Direct	5,492.9	21.0
Peabody Holding Company, Inc.	Methane	Other Direct	3,284.0	12.5
The Dow Chemical Company	HFC-134a	Other Direct	1,055.7	4.0
The Dow Chemical Company	Methane	Other Direct	1,020.3	3.9
Duke Energy Corporation	Methane	Stationary Combustion	808.5	3.1
Public Service Enterprise Group	Methane	Other Direct	723.3	2.8
Cinergy Corp.	Methane	Other Direct	361.2	1.4
Public Service Enterprise Group	Sulfur Hexafluoride	Other Direct	282.0	1.1
Southern Company	Sulfur Hexafluoride	Other Direct	222.0	0.8
Alcan Primary Metals Group – Sebree Works	Perfluormethane	Other Direct	158.5	0.6
NiSource/NIPSCO	Sulfur Hexafluoride	Other Direct	72.7	0.3
Total			**26,106.8**	**99.6**

Source: Energy Information Administration, Form EIA-1605.

Unit 2 returned to service in 1991, Browns Ferry Unit 3 returned to service in 1995, and Watts Bar Unit 1 started commercial operation in 1996. TVA's reported carbon dioxide emissions from stationary combustion sources for 2001 were 5 million metric tons above 1990 levels but 27 million metric tons below what they would have been if the 1990 generation mix and heat rates had been used.

IWSA reported two sources of indirect reductions: (1) by burning municipal solid waste to generate electricity, its members made it possible for electric utilities to burn less coal; and (2) if the municipal solid waste had not been burned, it could reasonably have been expected to be landfilled, and some portion of the landfilled waste would have decomposed anaerobically, producing

Table 29. Total Reported Entity-Level Carbon Dioxide Emission Reductions by Type and Source, Data Year 2001
(Million Metric Tons)

Type of Reduction and Emissions Source	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Direct Reductions											
Stationary Combustion	23.1	40.2	39.4	55.9	79.6	75.7	124.4	123.4	121.1	135.4	116.9
Transportation	*	*	*	0.1	0.1	0.1	*	*	*	0.1	*
Other Direct Sources	0.2	-1.2	-1.3	-1.4	-1.1	-0.8	-0.1	0.1	-0.1	*	-0.1
Total Direct	**23.2**	**39.0**	**38.1**	**54.7**	**78.6**	**75.0**	**124.3**	**123.5**	**121.1**	**135.5**	**116.7**
Indirect Reductions											
Purchased Power	*	-2.9	-4.4	-9.9	-8.6	0.5	3.2	10.3	10.6	-0.5	-6.5
Other Indirect Sources	12.9	13.7	13.3	15.2	18.8	20.5	20.5	20.9	23.9	24.6	25.3
Total Indirect	**12.9**	**10.8**	**8.9**	**5.3**	**10.2**	**21.0**	**23.8**	**31.3**	**34.5**	**24.1**	**18.8**
Carbon Sequestered	**0.6**	**1.6**	**6.0**	**6.1**	**6.8**	**6.9**	**7.7**	**7.9**	**7.9**	**7.3**	**7.5**

*Less than 0.05 million metric tons.
Note: Negative numbers indicate increases in emissions.
Source: Energy Information Administration, Form EIA-1605.

Table 30. Total Reported Entity-Level Reductions in Emissions of Other Greenhouse Gases by Gas and Source, Data Year 2001
(Thousand Metric Tons Carbon Dioxide Equivalent)

Gas and Type of Reduction	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Methane											
Direct	6,039.4	8,337.4	16,305.8	22,425.6	22,586.1	27,174.4	31,680.7	35,448.3	43,069.0	47,814.3	51,284.0
Indirect	1,732.2	2,713.0	3,162.2	3,562.1	3,954.8	4,646.7	5,643.3	6,305.8	7,388.2	8,599.4	9,538.1
Nitrous Oxide											
Direct	-2.6	-2.7	-2.6	-2.4	-1.7	-1.4	-1.6	-4.0	-5.1	-668.5	-25.6
Indirect	71.2	76.0	76.0	76.0	96.0	100.0	96.8	97.6	104.0	94.1	98.5
Hydrofluorocarbons											
Direct	—	—	—	*	*	5.6	2.8	-25.2	-79.7	-19.2	-1,035.2
Indirect	—	—	—	—	—	—	—	—	—	—	—
Perfluorocarbons											
Direct	-0.3	37.7	37.9	105.6	126.3	148.2	95.2	220.4	301.1	277.7	441.2
Indirect	3.1	3.3	4.0	7.3	7.3	14.8	16.7	20.8	11.1	9.5	20.9
Sulfur Hexafluoride											
Direct	-9.1	21.1	85.4	9.2	-73.9	-273.4	101.1	456.3	1,565.6	1,610.9	1,821.1
Indirect	—	—	—	—	—	—	0.1	0.1	0.1	0.1	0.1
Total											
Direct	6,027.4	8,393.4	16,426.4	22,538.1	22,636.7	27,053.5	31,878.4	36,095.8	44,850.9	49,015.2	52,485.6
Indirect	1,806.4	2,792.3	3,242.2	3,645.4	4,058.1	4,761.6	5,756.9	6,424.2	7,503.4	8,703.1	9,657.7

*Less than 0.05 thousand metric tons.
— = none reported.
Note: Negative numbers indicate increases in emissions.
Source: Energy Information Administration, Form EIA-1605.

methane emissions. Thus, IWSA reported that burning the waste reduced both fossil fuel burning and methane emissions on the part of others.

Thirty-one companies reported emission reductions or sequestration at the entity level using a "basic" reference case. A basic reference case is defined as total emissions in some baseline year—usually, but not always, 1990. In these cases, reductions were calculated as the difference between actual emissions in the data year and emissions in the baseline year. Of these 31 companies, 16 were electric power producers, including Consolidated Edison of New York, Inc., DTE Energy/Detroit Edison, Duke Energy Corporation, Florida Power Corporation, and Niagara Mohawk Corporation. Also reporting entity-level emission reductions using a "basic" reference case were 15 reporters that were not electricity producers, including Allergan, Inc., General Motors Corporation, International Truck and Engine Corporation, Lucent Technologies, Inc., Republic Metals Group, Rolls-Royce Corporation, and Sunoco, Inc.

For 2001, the Consol Coal Group reported the largest individual entity-level direct emissions reduction calculated with a basic reference case, at 19 million metric tons carbon dioxide, accounting for 11 percent of total reported carbon dioxide equivalent direct reductions during 2001. This direct reduction was from Consol's other direct source activities. In addition, the Niagara Mohawk Power Corporation, another entity-level reporter that relied on the use of a basic reference case to calculate emission reductions, reported the fourth

Table 31. Largest Individual Reported Entity-Level Direct Emission Reductions by Gas, Source, and Type of Reference Case Employed, Data Year 2001

Reporter	Gas	Source	Reference Case	Reported Direct Emission Reduction (Million Metric Tons Carbon Dioxide Equivalent)	Percent of Total Reported Direct Reductions
Tennessee Valley Authority	CO_2	Stationary Combustion	M	27.0	16.0
Consol Coal Group	CH_4	Other Direct	B	18.7	11.1
PG&E Corporation	CH_4	Other Direct	B	17.9	10.6
Niagara Mohawk Power Corporation	CO_2	Stationary Combustion	B	15.0	8.9
Duke Energy Corporation	CO_2	Stationary Combustion	M	14.3	8.4
FirstEnergy Corporation	CO_2	Stationary Combustion	M	14.2	8.4
Southern Company	CO_2	Stationary Combustion	M	11.6	6.9
FPL Group	CO_2	Stationary Combustion	M	9.0	5.3
Entergy Services, Inc.	CO_2	Stationary Combustion	M	6.7	4.0
Palmer Capital Corporation	CH_4	Other Direct	B	5.6	3.3
Public Service Enterprise Group	CO_2	Stationary Combustion	M	5.1	3.0
Jim Walter Resources, Inc.	CH_4	Other Direct	M	5.1	3.0
Constellation Energy Group, Inc	CO_2	Stationary Combustion	M	5.1	3.0
Reliant Energy – HL&P	CO_2	Stationary Combustion	M	4.8	2.8
Bethlehem Steel Corporation	CO_2	Stationary Combustion	M	3.8	2.2
The Dow Chemical Company	CO_2	Stationary Combustion	B	3.8	2.2
Florida Power Corporation	CO_2	Stationary Combustion	M	2.9	1.7
Municipal Electric Authority of Georgia (MEAG Power)	CO_2	Stationary Combustion	M	2.9	1.7
PG&E Corporation	CO_2	Stationary Combustion	M	2.4	1.4
KeySpan Energy Corporation	CO_2	Stationary Combustion	B	2.2	1.3
NiSource/NIPSCO	CH_4	Other Direct	M	2.1	1.3
General Motors Corporation	CO_2	Stationary Combustion	B	1.7	1.0
Alliant Energy	CO_2	Stationary Combustion	M	1.6	0.9
Hawaiian Electric Company, Inc.	CO_2	Stationary Combustion	B	1.5	0.9
Sunoco, Inc.	CO_2	Stationary Combustion	B	1.5	0.9
Total				**186.4**	**110.2**

B = Basic. M = Modified.
Note: Twenty-six participants in the Voluntary Reporting Program reported negative entity-level direct emissions reductions.
Source: Energy Information Administration, Form EIA-1605.

largest single direct emissions reduction at 15 million metric tons carbon dioxide, representing 9 percent of total reported carbon dioxide equivalent direct reductions for 2001.

Future Commitments To Reduce Emissions

The Voluntary Reporting Program also permits entities to report commitments to reduce emissions or to take action to reduce emissions in the future. In previous years, virtually all companies reporting future commitments were electric utility participants in the Climate Challenge voluntary program. However, 47 (55 percent) of the 85 future commitment reporters in 2001—including the Dow Chemical Company, Lucent Technologies, Inc., Noranda Aluminum, Inc., and Sunoco, Inc.—were not utilities. Fifteen of these nonutility reporters indicated that they were participants in other voluntary programs, such as Climate Wise for manufacturers and the Voluntary Aluminum Industrial Partnership.

There are three types of future commitments in the Voluntary Reporting Program: entity commitments, financial commitments, and project commitments. Entity and project commitments roughly parallel the entity and project aspects of emissions reporting: an entity commitment is a commitment to reduce the emissions of an entire organization; and a project commitment is a commitment to take a particular action that will have the effect of reducing the reporter's future emissions. A financial commitment has no emissions reporting counterpart: it is a commitment to spend a particular sum of money on emission reduction activities, without a specific promise on the emissions consequences of the expenditure. Most firms reported more than a single commitment, and many reported more than one type of commitment. Entity commitments are usually to make emissions lower than some level in a target year. Project commitments are usually to reduce emissions by a particular amount over a period of years. Because project commitments can cover a range of years, they are sometimes difficult to compare directly with project-level data for a single year of "achieved reductions."

Table 32. Largest Individual Reported Entity-Level Indirect Emission Reductions by Gas, Source, and Type of Reference Case Employed, Data Year 2001

Reporter	Gas	Source	Reference Case	Reported Indirect Emission Reduction (Million Metric Tons Carbon Dioxide Equivalent)	Percent of Total Reported Indirect Reductions
Integrated Waste Services Association	CO_2	Other Indirect	M	15.4	54.5
Integrated Waste Services Association	CH_4	Other Indirect	M	6.1	21.6
Southern Company	CO_2	Other Indirect	M	2.3	8.2
FPL Group	CO_2	Other Indirect	M	1.8	6.3
Portland General Electric Co.	CO_2	Purchased Power	M	1.8	6.2
Public Service Enterprise Group	CO_2	Purchased Power	M	1.6	5.8
Sacramento Municipal Utility District	CO_2	Purchased Power	B	1.3	4.5
Alliant Energy	CO_2	Other Indirect	M	1.0	3.4
PG&E Corporation	CH_4	Other Indirect	M	1.0	3.4
Los Angeles Department of Water and Power	CO_2	Purchased Power	B	0.9	3.3
FirstEnergy Corporation	CH_4	Other Indirect	M	0.9	3.2
CMS Energy	CO_2	Other Indirect	M	0.7	2.6
Cinergy Corp.	CH_4	Other Indirect	M	0.7	2.4
Reliant Energy – HL&P	CO_2	Other Indirect	M	0.6	2.3
PG&E Corporation	CO_2	Other Indirect	M	0.6	2.0
Peabody Holding Company, Inc.	CO_2	Purchased Power	B	0.5	1.9
Total				**37.2**	**131.0**

B = Basic. M = Modified.
Note: Twenty-four participants in the Voluntary Reporting Program reported negative entity-level indirect emission reductions.
Source: Energy Information Administration, Form EIA-1605.

Entity-Level Commitments

Twenty-five participants in the Voluntary Reporting Program reported entity-level commitments to reduce greenhouse gas emissions. These firms made promises to reduce, avoid, or sequester future emissions at the corporate level. As in the case of entity reporting, some commitments were to reduce emissions below a specific baseline, others to limit the growth of emissions per unit of output, and others to limit emissions by a specific amount in comparison with a baseline emissions growth trend. Participants reporting entity-level commitments to reduce greenhouse gas emissions in the future included Alliant Energy, FirstEnergy Corporation, FPL Group, IBM, Los Angeles Department of Water and Power, Niagara Mohawk Corporation, Noranda Aluminum Inc., and TVA.

In their reports for 2001, reporters of entity-level commitments pledged to reduce emissions in the future by 94 million metric tons carbon dioxide (Table 33), with 24 percent of the total coming from the TVA (23 million metric tons carbon dioxide), followed by the Los Angeles Department of Water and Power at 17 percent (16 million metric tons carbon dioxide), Niagara Mohawk Power at 16 percent (15 million metric tons carbon dioxide), FPL Group at 11 percent (10 million metric tons carbon dioxide), and City of Klamath Falls–Cogen at 7 percent (6 million metric tons carbon dioxide). These five commitments combined accounted for 75 percent (70 million metric tons carbon dioxide) of the total reported entity-level commitments to reduce greenhouse gases. TVA and FPL Group measured their reduction commitments using modified reference cases. The three others used basic reference cases.

Project-Level Commitments

Twenty-three companies reported on commitments to undertake 105 individual emission reduction projects. Some of the commitments were linked to future results from projects already underway and forming part of the reporters' submissions. Others were for projects not yet begun. Twenty-three reporters provided data on the quantities of reductions expected for 104 projects.

Reporters indicated that projects were expected to reduce future emissions by 151 million metric tons carbon dioxide equivalent. Of that amount, 60 percent (90 million metric tons) would be methane and 38 percent (57 million metric tons) would be carbon dioxide.

The single largest project-level commitment was made by Fidelity Exploration & Production Company (87 million metric tons carbon dioxide equivalent of methane), followed by TVA (18 million metric tons carbon dioxide) and FirstEnergy Corporation (4 million metric tons carbon dioxide). These three project-level commitments accounted for 72 percent of total reported project-level commitments (Table 34).

Fidelity's commitment is related to its Tongue River project, which involves pre-mining degasification of coal

Table 33. Largest Reported Individual Entity-Level Commitments To Reduce Greenhouse Gases by Gas and Type of Reference Case, Data Year 2001

Company	Gas	Reference Case	Carbon Dioxide Equivalent (Million Metric Tons)	Percent of Total Reported Reduction Commitments
Tennessee Valley Authority	CO_2	M	22.6	23.9
Los Angeles Department of Water and Power	CO_2	B	16.4	17.4
Niagara Mohawk Power Corporation	CO_2	B	15.1	16.1
FPL Group	CO_2	M	10.0	10.6
City of Klamath Falls- Cogen	CO_2	B	6.3	6.7
Entergy Services, Inc.	CO_2	B	5.0	5.3
FirstEnergy Corporation	CO_2	M	2.9	3.0
Alliant Energy	CO_2	M	2.4	2.5
Greater New Bedford Regional Refuse Mgt District	CH_4	M	2.1	2.3
Pacific Natural Energy, LLC	CH_4	M	2.1	2.2
South Carolina Electric & Gas Company	CO_2	B	1.8	1.9
Noranda Aluminum Inc.	CF_4	B	1.8	1.9
Alliant Energy	CO_2	M	1.8	1.9
Public Service Company of New Mexico	CO_2	B	1.5	1.5
Total			**91.7**	**97.2**

CO_2 = carbon dioxide. CH_4 = methane. CF_4 = perfluoromethane. B = Basic. M = Modified.
Note: Reporters are not asked to indicate whether future reductions will be direct or indirect.
Source: Energy Information Administration, Form EIA-1605.

deposits in the Powder River Basin of Wyoming and Montana. According to Fidelity, extraction of the methane, which is being sold to natural gas customers in large volumes, began in 2000. This project was reported as a commitment because the avoided methane emissions will not occur unless coal extraction begins sometime in the future. In the case of TVA, the project was described as "an increase in low emitting capacity," most likely a result of TVA's nuclear program. The FirstEnergy Corporation commitment was described as "undertaking supply side efficiency improvements."

Financial Commitments

Twenty-one companies, 18 of which were electric utilities, made a total of 35 financial commitments to reduce greenhouse gas emissions in the future. The total amount of funds promised was $51 million. The single largest reported financial commitment to reduce greenhouse gas emissions was that of Entergy Services, Inc., which committed to spend $25 million on a "carbon burnout plant" to make fly ash suitable for sale to cement companies, followed by Noranda Aluminum, Inc. ($5.5 million), Ameren Corporation ($5 million), and Minnesota Power ($3 million). FirstEnergy Corporation, CLE Resources, and Kansas City Power & Light Company each committed to spend $2 million. These seven companies reported financial commitments that together accounted for 87 percent of the reported total for 2001 (Table 35). The largest reported expenditures during 2001 were made by CLE Resources and Entergy Services, Inc. ($2 million each), followed by Noranda Aluminum, Inc. ($1.1 million) and Ameren Corporation ($0.5 million). Kansas City Power & Light Company and Dynegy Midwest Generation, Inc., each spent $0.4 million. These six expenditures combined accounted for 90 percent of the total reported expenditures in 2001 to reduce greenhouse gas emissions (Table 36).

Table 34. Largest Reported Individual Project-Level Commitments To Reduce Greenhouse Gas Emissions, Data Year 2001

Reporter	Project Description	Carbon Dioxide Equivalent (Million Metric Tons)	Percent of Total Reported Project Commitments
Fidelity Exploration & Production Company	Pre-mining degasification of coal deposits (Tongue River Project)	87.1	57.8
Tennessee Valley Authority	Increase in low-emitting capacity	17.6	11.7
FirstEnergy Corporation	Undertake supply-side efficiency improvements	4.4	2.9
City of Klamath Falls – Cogen	Commitment of $1.5 million to the Forest Resource Trust program to support reforestation of underproducing lands in western Oregon	3.0	2.0
FirstEnergy Corporation	Nuclear generation operation improvement	2.5	1.7
City of Klamath Falls – Cogen	Commitment to invest $1 million to extract useful energy for electricity production from a largely untapped source, methane.	2.5	1.6
Municipal Electric Authority of Georgia (MEAG Power)	Increase in nuclear unit availability	2.5	1.6
Alliant Energy	Modified forest management	2.4	1.6
Tennessee Valley Authority	Fuel switching	2.2	1.5
Greater New Bedford Regional Refuse Mgt District	Landfill gas control and future utilization	2.1	1.4
City of Klamath Falls- Cogen	Cogeneration of steam to displace fossil-fired boilers at an off-site industrial facility	2.0	1.3
CMS Energy	Use of large quantities of residue natural gas, currently being flared	2.0	1.3
Noranda Aluminum Inc.	Reduction of PFC emissions through anode effect reduction program	1.8	1.2
Alliant Energy	Other energy end-use projects/activities (electric)	1.7	1.1
PacifiCorp	Other energy end-use projects/activities	1.3	0.9
North American Carbon, Inc.	At Saint Felicien cogeneration project in Quebec, Canada, burning approximately 330,000 tons of green wood waste per year that would otherwise have been landfilled at a non-flared site	1.2	0.8
Santee Cooper	Cross Unit 2 retrofit	1.1	0.8
Municipal Electric Authority of Georgia (MEAG Power)	Increase in nuclear unit capacity	1.0	0.6
Santee Cooper	Upgrade to Summer nuclear station	0.9	0.6
Total		**139.3**	**92.4**

Source: Energy Information Administration, Form EIA-1605.

Table 35. Largest Reported Individual Entity-Level Financial Commitments To Reduce Greenhouse Gas Emissions, Data Year 2001

Reporter	Industry	Financial Commitment (Dollars)	Voluntary Program Affiliation	Percent of Total Reported Financial Commitments
Entergy Services, Inc.	Electric, Gas, and Sanitary Services	25,000,000	None	48.8
Noranda Aluminum Inc.	Primary Metals Industries	5,500,000	Voluntary Aluminum Industrial Partnership	10.7
Ameren Corporation (formerly UE and CIPS)	Electric, Gas, and Sanitary Services	5,000,000	Climate Challenge	9.8
Minnesota Power	Electric, Gas, and Sanitary Services	3,039,000	Climate Challenge	5.9
CLE Resources	Holding and Other Investment Offices	2,000,000	Climate Challenge	3.9
FirstEnergy Corporation	Electric, Gas, and Sanitary Services	2,000,000	Climate Challenge	3.9
Kansas City Power & Light Company	Electric, Gas, and Sanitary Services	2,000,000	None	3.9
City of Klamath Falls- Cogen	Services, not elsewhere classified	1,500,000	None	2.9
City of Klamath Falls- Cogen	Services, not elsewhere classified	1,000,000	None	2.0
PacifiCorp	Electric, Gas, and Sanitary Services	610,000	Climate Challenge	1.2
Bountiful City Light & Power	Electric, Gas, and Sanitary Services	517,296	Climate Challenge	1.0
City of Klamath Falls- Cogen	Services, not elsewhere classified	500,000	None	1.0
Dynegy Midwest Generation Inc.	Electric, Gas, and Sanitary Services	450,000	Climate Challenge	0.9
FirstEnergy Corporation	Electric, Gas, and Sanitary Services	400,000	Climate Challenge	0.8
Kansas City Power & Light Company	Electric, Gas, and Sanitary Services	264,000	Climate Challenge	0.5
Conectiv Atlantic Generation (CAG)	Electric, Gas, and Sanitary Services	200,000	Climate Challenge	0.4
FirstEnergy Corporation	Electric, Gas, and Sanitary Services	200,000	Climate Challenge	0.4
NiSource/NIPSCO	Electric, Gas, and Sanitary Services	200,000	Climate Challenge	0.4
Dynegy Midwest Generation Inc.	Electric, Gas, and Sanitary Services	105,000	Climate Challenge	0.2
TXU	Electric, Gas, and Sanitary Services	105,000	Climate Challenge	0.2
TXU	Electric, Gas, and Sanitary Services	105,000	Climate Challenge	0.2
City of Klamath Falls- Cogen	Services, not elsewhere classified	100,000	None	0.2
Constellation Energy Group, Inc.	Electric, Gas, and Sanitary Services	100,000	Climate Challenge	0.2
Total		**50,895,296**		**99.4**

Source: Energy Information Administration, Form EIA-1605.

Table 36. Reported Entity-Level Financial Expenditures To Reduce Greenhouse Gas Emissions, Data Year 2001

Reporter	Industry	2001 Financial Expenditure (Dollars)	Voluntary Program Affiliation	Percent of Total Reported Financial Expenditures
CLE Resources	Holding and Other Investment Offices	2,000,000	None	28.1
Entergy Services, Inc.	Electric, Gas, and Sanitary Services	2,000,000	None	28.1
Noranda Aluminum Inc.	Primary Metals Industries	1,113,495	Voluntary Aluminum Industrial Partnership	15.6
Ameren Corporation (formerly UE and CIPS)	Electric, Gas, and Sanitary Services	500,000	Climate Challenge	7.0
Kansas City Power & Light Company	Electric, Gas, and Sanitary Services	420,000	Climate Challenge	5.9
Dynegy Midwest Generation Inc.	Electric, Gas, and Sanitary Services	400,000	Climate Challenge	5.6
PacifiCorp	Electric, Gas, and Sanitary Services	218,067	Climate Challenge	3.1
NiSource/NIPSCO	Electric, Gas, and Sanitary Services	200,000	Climate Challenge	2.8
Bountiful City Light & Power	Electric, Gas, and Sanitary Services	160,647	Climate Challenge	2.3
Kansas City Power & Light Company	Electric, Gas, and Sanitary Services	35,000	Climate Challenge	0.5
TXU	Electric, Gas, and Sanitary Services	20,000	Climate Challenge	0.3
TXU	Electric, Gas, and Sanitary Services	20,000	Climate Challenge	0.3
Dynegy Midwest Generation Inc.	Electric, Gas, and Sanitary Services	10,000	Climate Challenge	0.1
Kansas City Power & Light Company	Electric, Gas, and Sanitary Services	10,000	Climate Challenge	0.1
Cleco Corporation	Electric, Gas, and Sanitary Services	5,000	Climate Challenge	0.1
NiSource/NIPSCO	Electric, Gas, and Sanitary Services	5,000	Climate Challenge	0.1
Xcel Energy	Electric, Gas, and Sanitary Services	5,000	Climate Challenge	0.1
Total		**7,122,209**		**100.0**

Source: Energy Information Administration, Form EIA-1605.

8. Project-Level Reporting on Form EIA-1605EZ

The Energy Information Administration (EIA) provides Form EIA-1605EZ to participants in the Voluntary Reporting of Greenhouse Gases Program as a less comprehensive and detailed alternative to Form EIA-1605. Form EIA-1605EZ allows reporters to provide a brief summary of their emission reduction projects for a single year, most recently 2001. The short form is used exclusively for reporting projects undertaken within the geographic boundaries of the United States, its territories and trusts. Because reports submitted on Form EIA-1605EZ do not make a distinction between owning or controlling an emissions source and simply initiating or participating in an emission reduction activity, there is no systematic way to distinguish between direct and indirect emissions reported on this form. Also, because the data reported in support of the emission reduction estimates are limited, it is difficult to perform anything but the most rudimentary arithmetic checks for accuracy.

Who Reported on Form EIA-1605EZ

Thirty-two entities submitted reports on Form EIA-1605EZ for 2001. Nineteen were electric power providers, typically relatively small electric power cooperatives. Seven were alternative energy providers, including one coal mine methane developer, one landfill gas-to-energy developer, and five firms that combusted biomass to reduce greenhouse gas emissions. Five were firms from the textile, chemical, refining, fabricated metals, and microprocessor industries, and one was an industry association.

What Was Reported on Form EIA-1605EZ

A total of 210 projects were reported on Form EIA-1605EZ for 2001 (Table 37), down from 229 projects reported on the short form for 2000 and from a peak of 252 projects reported on the short form for 1998. The decline from 2000 was made up almost entirely by a drop in the number of projects reported by three entities that had submitted reports for 2000 on a total of 21 carbon sequestration projects but reported only 2 projects for 2001. One of the three did not report at all for 2001, and the two others condensed 15 small projects reported for 2000 into 2 larger projects for 2001. Of the 210 projects reported for 2001, 64 focused on improvements in energy efficiency, 50 emphasized reductions in emissions from electricity generation, transmission, and distribution, and another 47 involved the capture and combustion of methane. Reporting on methane capture and combustion has grown steadily since 1994. For example, U.S. Energy Biogas Corp (formerly Zahren Alternative Power Corporation), which reported 10 projects for 1994, submitted reports for 41 projects on Form EIA-1605EZ for 2001.

Table 37. Number of Projects Reported on Form EIA-1605EZ by Reduction Objective and Project Type, Data Years 1994-2001

Reduction Objective and Project Type	1994	1995	1996	1997	1998	1999	2000	2001
Reducing Carbon Dioxide Emissions	**88**	**118**	**125**	**138**	**177**	**151**	**148**	**148**
Electricity Generation, Transmission, and Distribution	35	44	44	46	59	53	55	50
Cogeneration and Waste Heat Recovery	0	1	2	2	2	0	0	0
Energy End Use	44	50	53	60	66	56	61	64
Transportation and Offroad Vehicles	5	8	11	9	14	11	12	13
Other Projects	4	15	15	21	36	31	20	19
Reducing Methane and Nitrous Oxide Emissions	**15**	**21**	**30**	**32**	**41**	**45**	**44**	**47**
Waste Treatment and Disposal (Methane)	10	16	21	28	39	42	43	45
Agriculture (Methane and Nitrous Oxide)	0	0	0	0	0	0	0	0
Oil and Natural Gas Systems and Coal Mining (Methane)	5	5	9	4	2	3	1	2
Carbon Sequestration	**20**	**24**	**23**	**30**	**34**	**41**	**35**	**14**
Halogenated Substances	**2**	**1**	**1**	**1**	**0**	**0**	**2**	**3**
Total	**125**	**164**	**179**	**201**	**252**	**237**	**229**	**210**

Note: Table excludes projects submitted in confidential reports.
Source: Energy Information Administration, Form EIA-1605EZ.

Together, the 210 projects reported on the short form for 2001 reduced greenhouse gas emissions by 15 million metric tons carbon dioxide equivalent (Table 38). Of that total, 10 million metric tons resulted from efforts in the electricity generation, transmission, and distribution sector. Another 4 million metric tons was attributed to waste treatment and disposal, nearly all of which resulted from the capture and combustion of methane at municipal solid waste landfills (Table 39).

Federal voluntary programs played an important role in those projects reported on Form EIA-1605EZ. Of the projects reported, 180 (86 percent) were associated with some Federal voluntary initiative. Ninety-seven projects were associated with the Climate Challenge program, and 44 of the 45 waste treatment and disposal projects reported referenced the Landfill Methane Outreach Program (Table 40).

Table 38. Emission Reductions Reported on Form EIA-1605EZ by Reduction Objective and Project Type, Data Years 1994-2001
(Metric Tons Carbon Dioxide Equivalent)

Reduction Objective and Project Type	1994	1995	1996	1997	1998	1999	2000	2001
Reducing Carbon Dioxide Emissions	**3,718,577**	**4,962,359**	**4,407,922**	**6,682,313**	**16,385,934**	**9,588,970**	**9,161,905**	**10,864,669**
Electricity Generation, Transmission, and Distribution	2,260,679	2,882,369	2,114,294	3,801,703	13,039,812	8,118,198	7,838,882	9,685,215
Cogeneration and Waste Heat Recovery	—	10,319	13,542	10,344	109,828	—	—	—
Energy End Use	1,361,188	1,573,674	1,910,306	2,353,454	2,393,956	334,120	358,707	310,765
Transportation and Offroad Vehicles	10,398	9,943	12,144	14,121	16,518	1,873	2,064	2,678
Other Projects	86,312	486,053	357,636	502,690	825,819	1,134,779	962,253	866,011
Reducing Methane and Nitrous Oxide Emissions	**564,022**	**1,152,190**	**1,258,256**	**1,825,780**	**3,028,286**	**3,226,071**	**3,086,281**	**3,954,618**
Waste Treatment and Disposal (Methane)	560,914	1,146,893	1,245,224	1,808,738	2,973,247	3,174,198	3,085,240	3,773,702
Agriculture (Methane and Nitrous Oxide)	—	—	—	—	—	—	—	—
Oil and Natural Gas Systems and Coal Mining (Methane)	3,108	5,297	13,032	17,042	55,039	51,872	1,041	180,916
Carbon Sequestration	**2,470**	**7,569**	**2,519**	**5,466**	**4,025**	**71,048**	**5,081**	**9,088**
Halogenated Substances	**—**	**—**	**—**	**123,049**	**—**	**—**	**20,744**	**11,327**
Total	**4,285,069**	**6,122,117**	**5,668,697**	**8,636,608**	**19,418,245**	**12,886,089**	**12,274,012**	**14,839,701**

— = none reported.
Note: Table excludes data submitted in confidential reports.
Source: Energy Information Administration, Form EIA-1605EZ.

Table 39. Carbon Dioxide and Methane Emission Reductions Reported on Form EIA-1605EZ by Reduction Objective and Project Type, Data Year 2001
(Metric Tons of Gas)

Reduction Objective and Project Type	Carbon Dioxide	Methane
Reducing Carbon Dioxide Emissions	**10,832,093**	**19,596**
Electricity Generation, Transmission, and Distribution	9,672,234	—
Cogeneration and Waste Heat Recovery	—	—
Energy End Use	310,765	—
Transportation and Offroad Vehicles	2,678	—
Other Projects	846,415	19,596
Reducing Methane and Nitrous Oxide Emissions	**13,866**	**3,940,752**
Waste Treatment and Disposal (Methane)	13,158	3,760,544
Agriculture (Methane and Nitrous Oxide)	—	—
Oil and Natural Gas Systems and Coal Mining (Methane)	708	180,208
Carbon Sequestration	**9,088**	**—**
Halogenated Substances	**—**	**—**
Total	**10,855,046**	**3,960,348**

— = none reported.
Notes: No reductions of nitrous oxide emissions were reported on Form EIA-1605EZ for 2001. Table excludes data submitted in confidential reports.
Source: Energy Information Administration, Form EIA-1605EZ.

Table 40. Number of Projects Reported on Form EIA-1605EZ Associated with Other Federal Voluntary Programs, Data Years 1994-2001

Voluntary Program	1994	1995	1996	1997	1998	1999	2000	2001
Climate Challenge	106	127	117	124	129	114	111	97
Landfill Methane Outreach Program	—	—	2	2	34	40	42	44
Climate Wise Recognition Program		3	5	12	25	25	12	1
Energy STAR Buildings Program	—	—	—	—	—	—	—	6
Coalbed Methane Outreach Program	—	—	1	1	2	3	—	—
Natural Gas STAR	5	5	8	3	—	—	—	—
Other	5	17	22	21	26	20	19	32
Total	**116**	**152**	**155**	**163**	**216**	**202**	**184**	**180**

— = none reported.

Notes: Totals may not equal sum of components, because some projects are associated with more than one voluntary program. Table excludes data submitted in confidential reports.

Source: Energy Information Administration, Form EIA-1605EZ.

Glossary

Afforestation: Planting of new forests on lands that have not been recently forested.

Anaerobic lagoon: A liquid-based manure management system, characterized by waste residing in water to a depth of at least 6 feet for a period ranging between 30 and 200 days.

Associated natural gas: See associated-dissolved natural gas.

Associated-dissolved natural gas: Natural gas that occurs in crude oil reservoirs either as free gas (associated) or as gas in solution with crude oil (dissolved gas).

Baseline period: The years 1987 through 1990 for which entity-level emissions may be reported.

Biofuels: Liquid fuels and blending components produced from biomass (plant) feedstocks, used primarily for transportation.

Biogas: A mixture of carbon dioxide and methane produced through bacterial action.

Biomass: Organic nonfossil material of biological origin constituting a renewable energy source.

British thermal unit: The quantity of heat required to raise the temperature of 1 pound of liquid water by 1 degree Fahrenheit at the temperature at which water has its greatest density (approximately 39 degrees Fahrenheit).

Carbon sink: A reservoir that absorbs or takes up released carbon from another part of the carbon cycle. The four sinks, which are regions of the Earth within which carbon behaves in a systematic manner, are the atmosphere, terrestrial biosphere (usually including freshwater systems), oceans, and sediments (including fossil fuels).

Carbon Sequestration: The fixation of atmospheric carbon dioxide in a carbon sink through biological or physical processes.

Chlorofluorocarbon (CFC): Any of various compounds consisting of carbon, hydrogen, chlorine, and flourine used as refrigerants. CFCs are now thought to be harmful to the earth's atmosphere.

Cogeneration: The production of electrical energy and another form of useful energy (such as heat or steam) through the sequential use of energy.

Commercial scale: Application of a demonstrated technology at a cost-effective scale.

Commitment: An expressed intention to undertake an action or actions that will reduce greenhouse gas emissions, increase carbon sequestration, or achieve a stated emissions goal.

Conversion factor: A number that translates units of one measurement system into corresponding values of another measurement system. *Note:* For specific conversion factors, see EIA data products.

Deforestation: The net removal of trees from forested land.

Emissions coefficient: A unique value for scaling emissions to activity data in terms of a standard rate of emissions per unit of activity (e.g., pounds of carbon dioxide emissions per unit of fossil fuel consumed).

Emissions: Anthropogenic releases of gases to the atmosphere. In the context of global climate change, they consist of radiatively important greenhouse gases (e.g., the release of carbon dioxide during fuel combustion).

Emissions, direct: Emissions from sources owned (wholly or in part) or leased by an entity.

Emissions, fugitive: Unintended leaks of gas from the processing, transmission, and/or transportation of fossil fuels.

Emissions, indirect: Emissions from sources not owned or leased by an entity that occur, wholly or in part, as a result of its activities.

Emission reduction: A decrease in annual greenhouse gas emissions.

Energy conservation: Activities that reduce end-use demand for energy by reducing the service demanded.

Entity: For the purposes of the Voluntary Reporting Program, an individual or organization that is a legal U.S. person (e.g., a U.S. citizen, resident alien, company, organization, or group incorporated under or recognized by U.S. law; or a Federal, State, or local government agency).

Entity boundary: Conceptually, a line drawn to encompass the emissions sources and sinks to be evaluated in an entity-level report. An entity boundary should

include all the emissions sources and sinks owned (wholly or in part) or leased by the entity and, to the extent possible, other emissions sources and sinks affected by the entity's activities.

Entity-level reporting: The reporting of greenhouse gas emissions, emission reductions, and carbon sequestration for an entire entity.

Estimation method: The techniques, including key assumptions and data sources, used by the reporter to derive the reported emissions, emission reductions, or sequestration.

Foreign activities: All actions outside the United States, its territories, and trusts.

Fossil fuel: An energy source formed in the Earth's crust from decayed organic material. The common fossil fuels are petroleum, coal, and natural gas.

Fuel cycle: The entire set of sequential processes or stages involved in the utilization of fuel, including extraction, transformation, transportation, and combustion. Emissions generally occur at each stage of the fuel cycle.

Fuel switching: The substitution of one type of fuel for another. The fuel substitution may be either temporary (as in the case of a power plant that temporarily switches from coal to natural gas) or permanent (as in the case of a fleet operator who replaces gasoline-powered automobiles with electric cars).

Fugitive emissions: See Emissions, fugitive.

Global warming potential (GWP): An index used to compare the relative radiative forcing of different gases without directly calculating changes in their atmospheric concentrations. GWPs are calculated as the ratio of the radiative forcing that would result from the emission of one kilogram of a greenhouse gas to that from the emission of one kilogram of carbon dioxide over a fixed period of time, such as 100 years.

Gob: A zone of rubble created when the roof of a coal mine collapses behind the mining operations.

Greenhouse effect: The result of water vapor, carbon dioxide, and other atmospheric gases trapping radiant (infrared) energy, thereby keeping the Earth's surface warmer than it would otherwise be. Greenhouse gases within the lower levels of the atmosphere trap infrared radiation that would otherwise escape into space, and subsequent re-radiation of some of the energy back to the Earth maintains higher surface temperatures than would occur if the gases were absent. See Greenhouse gases.

Greenhouse gases: Those gases, such as water vapor, carbon dioxide, nitrous oxide, methane, hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulfur hexafluoride, that are transparent to solar (short-wave) radiation but opaque to long-wave (infrared) radiation, thus preventing long-wave radiant energy from leaving Earth's atmosphere. The net effect is a trapping of absorbed radiation and a tendency to warm the planet's surface.

Halogenated substance: A volatile compound containing halogens, such as chlorine, fluorine, or bromine.

Horizon year: The year in which a commitment to reduce greenhouse gas emissions or increase sequestration (reported on Schedule IV) is expected to be met.

Intergovernmental Panel on Climate Change (IPCC): A panel established jointly in 1988 by the World Meteorological Organization and the United Nations Environment Program to assess scientific information related to climate change and to formulate realistic response strategies.

Life cycle: The progression of a product through its service life. For most products, emissions and energy-consuming characteristics will be altered as they age.

Longwall mining: An automated form of underground coal mining characterized by high recovery and extraction rates, feasible only in relatively flat-lying, thick, and uniform coalbeds. A high-powered cutting machine is passed across the exposed face of coal, shearing away broken coal, which is continuously hauled away by a floor-level conveyor system. Longwall mining extracts all machine-minable coal between the floor and ceiling within a contiguous block of coal, known as a panel, leaving no support pillars within the panel area. Panel dimensions vary over time and with mining conditions but currently average about 900 feet wide (coal face width) and more than 8,000 feet long (the minable extent of the panel, measured in direction of mining). Longwall mining is done under movable roof supports that are advanced as the bed is cut. The roof in the mined-out area is allowed to fall as the mining advances.

Manure management: The method used to dispose of the solid waste produced by livestock and poultry.

Municipal solid waste: Residential solid waste and some nonhazardous commercial, institutional, and industrial wastes.

Ozone: A molecule made up of three atoms of oxygen. Occurs naturally in the stratosphere and provides a protective layer shielding the Earth from harmful ultraviolet radiation. In the troposphere, it is a chemical oxidant, a greenhouse gas, and major component of photochemical smog.

Photosynthesis: The manufacture of carbohydrates and oxygen from carbon dioxide and water in the presence of chlorophyll, with sunlight as the energy source. Carbon is sequestered and oxygen and water are released in the process.

Pilot project: A small-scale trial designed to test or demonstrate the efficiency or efficacy of a project.

Project: An action undertaken to reduce greenhouse gas emissions or sequester carbon.

Project boundary: Conceptually, a line drawn to encompass the emissions sources and sinks affected by a project. A project boundary should include all the significant and quantifiable effects of the project.

Project ID code: A unique code assigned by the Energy Information Administration to a reported project for tracking purposes.

Project-level reporting: Reporting on emission reductions or carbon sequestration achieved as a result of a specific action or group of actions.

Reconductoring: Replacement of existing conductors with large-diameter conductors to reduce line losses. Conductors (including feeders and transmission lines) are a major source of transmission and distribution system losses. In general, the smaller the diameter of the conductor, the greater its resistance to the flow of electric current, and the greater the consequent line losses.

Reference case: The emissions level to which current actual emissions levels are compared when emission reductions are calculated.

Reference case, basic: A reference case using actual historical emissions or sequestration values.

Reference case, modified: A reference case using projected emissions or sequestration values, representing the emissions level that would have occurred in the absence of reduction or sequestration efforts.

Reforestation: Replanting of forests on lands that have recently been harvested or otherwise cleared of trees.

Reporter: An entity (see definition above) completing either Form EIA-1605 or Form EIA-1605EZ and submitting it to the Energy Information Administration.

Room-and-pillar mining: The most common method of underground mining in which the mine roof is supported mainly by coal pillars left at regular intervals. Rooms are places where the coal is mined; pillars are areas of coal left between the rooms. Room-and-pillar mining is done either by conventional or continuous mining.

Sequestered carbon: Carbon that is removed from the atmosphere and retained in a carbon sink (such as a growing tree) or in soil.

Sink: See Carbon sink.

Third-party reporter: An authorized party that submits a report on behalf of two or more entities that have engaged in emissions-reducing or sequestration-increasing activities. Possible third-party reporters include trade associations reporting on behalf of members that have undertaken reduction projects.

Vhar metering: Phase shifters on watt-hour meters that measure reactive volt ampere hours or varhours.

Watt (W): The unit of electrical power equal to one ampere under a pressure of one volt. A watt is equal to 1/746 horsepower.